Nested Loop Antennas

This low-cost five band loop array blends into the background.

G. Scott Davis, N3FJP

This multi-band nested loop antenna array replaces my tribander Yagi, which is only up 20 feet. Inspired by suggestions from Bill Wisel, K3KEI, I first tried a full wave 20 meter band square loop antenna. On the air comparisons with my low Yagi confirmed instantly that this design was a hands-down winner for working both local and distant stations.

I replaced that mono-band loop with a nested loop array for the 20, 17, 15, 12, and 10 meter bands. The antenna blends into the surroundings, so I needed the morning sun shining directly on it to snap the lead photo.

This became a nice father-son project with my son Brad, KB3MNE. Here's how we built the antenna.

This stealthy nested loop is almost invisible among the trees.

Construction

We constructed the square loops shown in Figure 1 according to the dimensions in Table 1. The loops hang from a tree limb in the vertical plane. Because I feed them from the bottom corners, the loops radiate horizontal polarization.

Calculate the perimeter size, *P*, of each loop by dividing the frequency in MHz into 1005 feet. Table 1 shows the loop dimensions. Start with the 20 meter loop, the largest loop. Cut a 70.90 foot segment of wire for the loop perimeter length, *P*. Divide the perimeter length by 4 to determine the length, *S*, of each side. The PVC pipe horizontal cross support spans between opposite loop corners, and is 1.41 times the largest loop side length, *S*. We used brass screws to hold the PVC together. Lay your antenna wire out on the structure, temporarily taping it to find where the wire should pass through the PVC pipe. Drill holes through the pipe for the loop wire. After you run the wire through the holes, wrap a bit of electrical tape on each side of the wire next to the pipe to keep the wire from sliding and to give the pipe additional support. Next, cut and thread the wires for the rest of the bands.

The horizontal PVC pipe sagged and bowed significantly even though the antenna wires help support the horizontal PVC pipe pieces. We remedied the sagging by taping lengths of 1 × 2 inch pressure treated wood to the horizontal arms. At the bottom, rather than sliding the wires through the PVC pipe, we put brass wood screws into the PVC to hang the dipole connectors seen in Figure 2.

Matching and Feeding

Each loop antenna feed point impedance is about 100 Ω, so we used individual quarter wave 75 Ω coax matching sections to convert the impedance to 50 Ω. Carefully cut 75 Ω coax to the lengths *L* specified in Table 1. Those lengths, taking into account velocity factor $v = 0.66$, are $L = 246v/F_{MHz}$ feet. Connect one end of the 75 Ω coax to the loop using a dipole center connector, as seen in the lead photo. The other end connects to the 50 Ω coax feed line using

Table 1
Nested Loop Antenna Dimensions; 75 Ω Matching Section Cable has 0.66 Velocity Factor

Band	Frequency, MHz	Perimeter, *P*, ft	Side, *S*, ft	Cross Support, ft	Distance From Center, *D*, ft	Length, *L*, of 75 Ω cable
20 m	14.175	70.90	17.72	24.81	12.41	11.45
17 m	18.118	55.47	13.87	19.41	9.71	8.96
15 m	21.225	47.35	11.84	16.57	9.29	7.65
12 m	24.940	40.30	10.07	14.10	7.05	6.51
10 m	28.500	35.26	8.82	12.34	6.17	5.70

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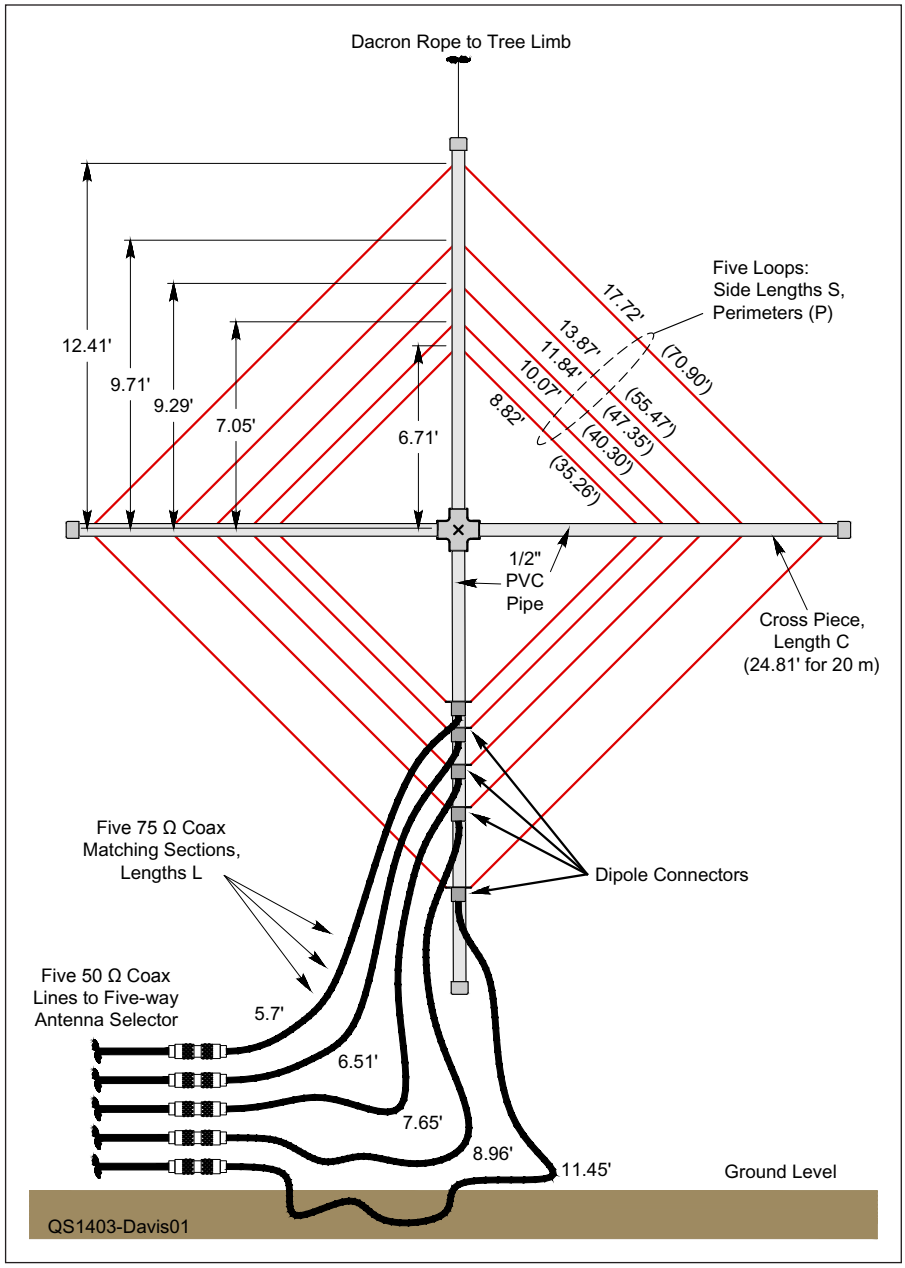

Figure 1 — The five-band loop antenna and construction overview.

Antenna wire — #12 AWG black insulated stranded copper wire, 250 feet (**homedepot.com**).
Coax cable — 75 Ω, 41 feet (RG11A/U or RG59B/U **www.thewireman.com**).
CQ dipole center hang, SO239 connector, 5 units (Part #801 **www.thewireman.com**).
Double barrel female SO-239 connectors, 5 units
PL259 coax connectors, 10 units.
50 feet of ½" PVC tubing (four 12.5" sections).
PVC 4 way connector, ½".
PVC ½""end caps, 4 units.
Wood stiffeners, 1" × 2" × 8" (optional) pressure treated wood.
Dacron UV resistant 3⁄16" rope (Part #816 **www.thewireman.com**).
Brass wood screws, #6 x 1½", and PVC cement.

a double barrel female SO-239 connector. I select the appropriate antenna by an antenna switch controller in my ham shack.

Conclusion

My nested loop array works well on all five bands. There is little interaction between the antenna elements, and the signal reports are very encouraging. You can build a single loop for your favorite band, or nest multiple loops. You can even add 6 and 2 meters if you like. [Be sure to see the compliance tables in *RF Exposure and You* by Ed Hare, W1RFI. — *Ed.*][1]

Figure 2 —The five SO239 dipole connectors attach the loops to 75 Ω coax quarter wave matching sections. Brad, KB3MNE, points to the 17 meter connector.

Photos by the author.

G. Scott Davis, N3FJP, holds an Amateur Extra class license. He was first licensed in 1976 as WB3CZF. Scott shares his interest in Amateur Radio and programming with his wife Kimberly, KA3SEQ, and sons Christopher, KB3KCN, and Bradley, KB3MNE. You can reach Scott at **snkdavis@aol.com**.

[1]Available from your ARRL dealer, or from the ARRL Store, ARRL order no. 6621. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/; pubsales@arrl.org.**

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