Tech corner – Horizontal loop antenna

One of the drawbacks of a non-directional antenna is its knack of receiving noise from all directions. But a highly directional antenna must be rotated to direct or pick up signals effectively enough for you to operate the distant station. There is no magic antenna, but if you can find one that seems to both transmit your signal well and receive many stations with a low noise level, a horizontal loop might just be your next discovery.

Building a loop antenna is fairly easy, because it only has two parts, the wire element and a 4:1 current balun (the wire element is the balanced part, while the coax is the unbalanced part.) You can build your own 4:1 current balun, but I'm listing a commercially sold one by Balun Designs (I used the 4115et) as a quick alternative. Simply connect the wire in a loop to both sides of the balun, attach the coax, and hoist away. Well, almost that simple. The antenna should occupy as much area as possible, so a square formation might be ideal, but that's a lot of real estate.

To take advantage of his experience, I stole some tips for this antenna from a good friend, Kevin Bowen K7SW and his video. He suggests using long poles to hoist each corner of the antenna into place.

Parts list

290 feet 18 AWG stranded wire

Four dogbone insulators

One Alpha-Delta ATT3G50U arrester

Two 14-8 crimp sleeves

One ground clamp

One 30-foot RG-8X coax with PL-259

One Balun Designs 4115 4:1 current balun

Four bundles 100-foot paracord 550

One ½″ 8-foot ground rod

Four 18-inch stakes with holes

One 2″ corner brace

Two ¼″ 18 AWG ring terminals

Construction

Thread the wire through one end in each of the four dogbone insulators. Thread one end of the wire through a crimp sleeve, then through an eyebolt on the side of the balun, then through the same crimp sleeve from the opposite direction. Crimp the sleeve. Strip the end of the crimped wire, and solder a ring terminal on it. Secure the ring terminal onto the eyebolt.

Strip the other end of the wire and clamp the bared end onto the balun with the unused balun side eyebolt, so that you can change the length of the wire as you tune it. Raise the entire antenna about five feet off the ground so you can work on it and tune it. Yes, that's easier said than done, but do your best. Tie paracord to the unused end of each dogbone insulator.

Attach an antenna analyzer to the balun by a short (3-foot) coax, and measure the SWR for the 40-meter band, to start. The response might appear resonant (the dip location) at a frequency lower than the amateur 40-meter band (left photo). If so, shorten the wire a little (a foot or so at a time) and re-measure. Your goal is to have the dip appear within the amateur band, or at least have the entire SWR bandwidth (2.0:1) within the 40-meter band (right photo).

Horizontal loop antenna, continued

Due primarily to velocity factor, the full-wave horizontal loop antenna ended up at between 280 feet and 275 feet long for me, making a 70 foot x 70 foot square. You can create a 40-meter version by simply using 138 feet to 140 feet of wire, especially if you don't have enough area on your property (35 feet x 35 feet square) to accommodate the entire loop.

Even though my own wire ended up being ideal right at 278 feet 3 inches, I don't insist that you cut yours exactly the same length, because your circumstances might differ. Your wire height above ground will be different from mine, your soil conductivity will be slightly different from mine, your surroundings (vehicles, ductwork, gutters, etc.) will be different from mine, all affecting SWR and feed point impedance differently. Connect the coax from your transceiver to the balun SO-239 connector, and you're ready to raise the antenna.

Grounding

If you plan to install your HF horizontal loop antenna permanently or plan to install it during a potential thunderstorm temporarily, you'll want to ground it for lightning safety. Drive the ground rod into the Earth below where the balun is mounted. If this is a temporary installation, just cut about five feet off the ground rod from the non-pointed end, then drive the pointed end of the remaining 3-foot section into the Earth.

Attach the arrester to the corner brace, attach the ground clamp to the ground rod, then attach the corner brace to the ground clamp. You might need to do some drilling to get the bolts to fit through the corner brace. Connect the 30-foot coax between the balun SO-239 connector and one end of the arrester. The coax from your transceiver will connect to the other end of the arrester.

Installation and testing

Locate a place away from power lines where you can raise the loop antenna about 25 or more feet. Installing it up in trees is a good goal if you can raise each corner that high. Secure each corner by tying the paracord to an 18˝ stake. It's ok to mount the loop around your house, but do your best to keep the area within the

Horizontal loop antenna, continued

loop as free of conductive objects as possible. Typically, the higher you raise your antenna, the farther it will be from your house.

Test the antenna with your analyzer again, and bring it down and re-tune your wire, as needed. Once you get the SWR bandwidths within the bands of interest, you're ready to start using your antenna. Because one amateur HF band is often a harmonic of another, if the antenna works for one band, it'll likely work on another. Keep in mind that a dummy load exhibits perfect SWR across many bands, but doesn't perform very well, so a perfect SWR on your antenna is only a starting point for operating effectiveness.

The real test comes when you get on the air and use your antenna to contact operators in another state, then another country, then another continent. You'll likely find that the noise level on HF while using the horizontal loop is down 6 dB, 12 dB, or more. Use the WebSDR to listen to difficult-to-copy signals and to watch how it receives your own signals.

Summary

A full-wave horizontal loop antenna is nothing more than a long wire that connects both balanced ends of a 4:1 current balun. The loop is very quiet because of its radial directivity, and so has some gain, therefore rejecting some of the noise otherwise received by an end-fed or dipole antenna. Although simple in concept, it can be difficult to install because of its full-wavelength wire, requiring both mounting area and height to work effectively.

Noji Ratzlaff, KN0JI (kn0ji@arrl.net)