A Uniquely Tuned 2 Meter Transmitter Hunting Loop

This compact, inexpensive, easy-to-build loop is ideal for close-in direction finding and transmitter-hunting.

John Portune, W6NBC

One of the hidden joys of transmitter hunting is that it provides an excuse for homebrewing. As a new participant in this radiosport, I found myself constructing antennas I never would have considered for other activities. This little loop is a perfect example (see Figure 1).

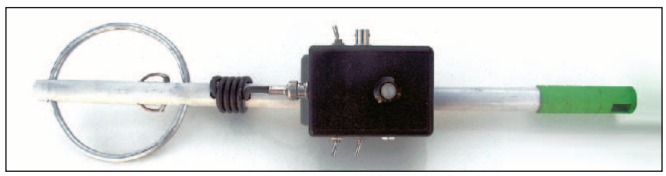

Figure 1 — Left to right, loop, coupling loop, balun, attenuator and handheld transceiver mount (behind attenuator).

The Basic Dynamics of Transmitter Hunting

At the starting point of a transmitter hunt, one needs high gain — a Yagi or quad, and a sensitive receiver. As you approach the hidden transmitter, however, the game changes dramatically. Now you need a portable antenna and an attenuator. This is the realm of the loop or a hand-held Yagi. I prefer the loop. It's handier and, in most cases, just as effective.

Loop Sensitivity

Compared to a Yagi or a quad, a small loop has downsides, even though it does have equally good directivity. One is its size, which does not let it capture as much signal, particularly if not tuned to the frequency of the transmitter. Commercially manufactured direction finding (DF) loops are often not tuned. They are designed this way to permit them to be used on more than one band.

I preferred to increase my loop's ability to receive by tuning it to 2 meters with a variable capacitor at the loop's ends. The loop's untuned resonance is roughly 450 MHz, making it inefficient on 2 meters. For locating radio-tagged wild animals, finding memory impaired patients or locating a VHF aviation beacon, it is easy to retune the capacitor for another VHF band.

I chose a somewhat unconventional variable capacitor simply because common rotary and compression mica variables are awkward to add to a loop. Furthermore, they are becoming hard to find. At first I did not know what kind of variable capacitor to use. Then lightning struck.

Why not dispense with using a discrete capacitor at all? Let the loop itself be one of the plates of a variable capacitor by constructing it of tubing instead of solid rod or wire. The other plate of the capacitor is 11½ inches of the center conductor and dielectric of a piece of RG-8X coax, with the black outer jacket and shield removed. It's inserted inside the tubing of the loop as shown in Figure 2.

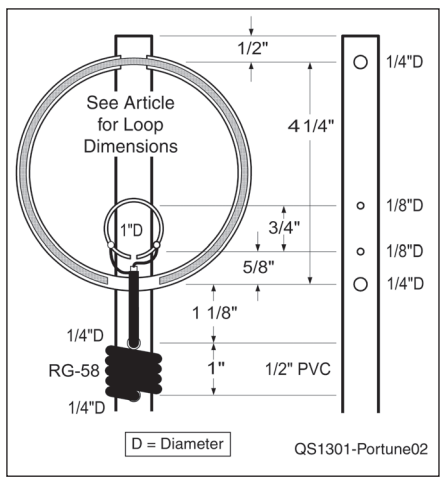

Figure 2 — The transmitter hunting loop. Note that a tuning capacitor is formed by the tubing of the loop itself and an inserted length of the inner conductor and dielectric from RG-8X coax.

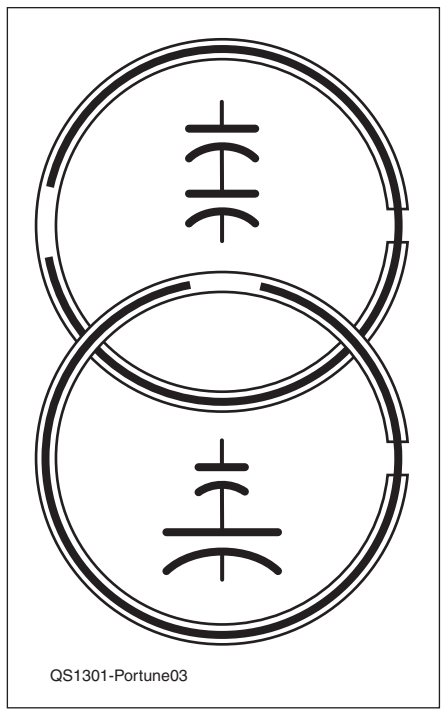

Figure 3 — Cross sections of the loop with coax inner conductor and dielectric from RG-8X coax in two different positions. Maximum capacitance is with the inner conductor as in the top loop.

Notice that this design creates two capacitors in series. One is above the gap, the other is below it. As illustrated in Figure 3, when the sides are equal total capacitance is maximum. Move the sliding piece to either side and the capacitance decreases, increasing the resonant frequency. Note the equivalent circuit of the two capacitors.

Therefore, to adjust the frequency of the loop you merely slide the coax inner conductor and dielectric with your fingernail at the gap in the top end of the boom. See Figure 4.

The tuning is very stable. I've never needed to retune my loop, though I did have to experiment, using an antenna analyzer, with tubing size and inner conductor length to find the right combination. Just duplicate the dimensions and you will have no trouble tuning the loop.

Figure 4 — Loop from the top end. Tune the loop by sliding the coax inner conductor and dielectric with your fingernail.

Figure 5 — Carol Adams, KG6VLG, demonstrating the use of *body fade*. Note the placement and orientation of the loop. She is facing the hidden transmitter.

The Small Coupling Loop

There are several possible ways to match the loop to 50 Ω coax. I use compact and flexible RG-58 for this application. From practical experience with small loops, I have found that an inductive coupling loop is the easiest matching method. This one is 1 inch in diameter, made from #14 AWG solid copper wire. Note that there is a gap in it inside the boom. Solder the feed coax, as shown, to the coupling loop just outside of the boom. There is no electrical connection to the main loop. The two constitute an RF transformer with energy passing via magnetic induction.

Tuning the Antenna

The easiest way to tune up the antenna is with an antenna analyzer such as an MFJ-259 or equivalent. Begin by centering the coax inner conductor. Next find the resonant frequency by sweeping across the VHF band with the antenna analyzer connected to the feed coax and looking for the SWR dip. It will be below the 2 meter band at first. Again, don't concern yourself with SWR. If you later want to use the loop for transmitting, you can then fine tune the coupling loop for a better match. For receiving, the dimensions shown are entirely adequate.

Slide the coax inner conductor with your fingernail in small increments. Each time, again find the dip. Gap length increments work fine. Repeat the process until you reach the desired frequency. I easily tuned up a dozen new loops this way one afternoon at a radio club build-it session.

Building the Loop

The vertical boom is a length of common ½ inch PVC water pipe, visible in Figure 2. The pipe shown is actually the handle of a dust pan. It is a little lighter and has a nice feel.

Construction is very straightforward. Cut and bend the loops with your fingers. A form is not necessary. Then drill the holes in the boom for the loops and balun. Next, rotate the loops into place through the holes and add the coax, forming the balun as you go. Finally, solder the ends of the coax to the coupling loop and attach a connector.

An Attenuator

To use the loop as part of the sport of radio transmitter hunting you will need an attenuator. It cuts down the strong signals as you get close to the hidden transmitter. Without it, your receiver will saturate and you will lose the ability to determine directions through peaks and nulls.

Two types of attenuator are common. One operates with the receiver "on channel" and attenuates with switchable resistive pads or a potentiometer. The other, called an *off-set* attenuator, mixes the incoming signal with a local crystal oscillator, typically at 2 or 4 MHz. Hence, you listen high or low. With a resistive on-channel attenuator your receiver needs to be shielded to prevent direct pickup through the case. An off-set attenuator is much simpler to use.

I also made the boom long enough to accept glued-on rectangles of PVC, cut from a blank 120 V ac duplex PVC outlet box cover plate. You attach the attenuator and 2 meter handheld transceiver to these using squares of stick-on hook and loop fastener.

The Balun

Also essential to all transmitter hunt antennas is a balun. If it is omitted, the antenna pattern will be skewed, which could lead you in the wrong direction.

As above, drill four additional holes in the boom to secure it. This type of balun is an RF choke formed of five turns of the feed coax. VHF ferrite beads may also be used.

Using the Loop

When using this antenna, keep in mind that there are two nulls and two peaks. The peaks occur when the loop is in line with the hidden transmitter, the nulls when it is broadside. To resolve this all you need is a very elementary transmitter hunting technique called *body fade*.

With the loop held close to your chest, and also in line with the transmitter, turn in a full circle. You will still get two peaks (and two nulls). But with your body present the correct and stronger peak will occur when you are facing the hidden transmitter (see Figure 5). Once you know the right direction, hold the loop high above your head. The peaks and nulls will be more evident.

Many good construction and operating tips for transmitter hunting may be found on our radio club's website, **satellitearc.com**. Of particular value is an audible S meter that we dub "the screamer," developed by veteran transmitter hunter David E. Dowler, KA6BFB. A variable tone eliminates the need to look at the S meter on your handheld. Also, the screamer has a much wider signal strength range.

Try this inexpensive little loop at your next transmitter hunt. You will be pleased. Also consider it as a radio club build-it project. It was a big hit at mine.

ARRL member and Amateur Extra class licensee John Portune, W6NBC, received a BSc in physics from Oregon State University in 1960 and a BA in liberal arts and communications from Ambassador College in Pasadena, California in 1963. He earned an FCC Commercial General Radiotelephone license and an FCC Radiotelegraph license. John retired as a broadcast television engineer and technical instructor at KNBC in Burbank and then from Sony Electronics in San Jose, California.

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