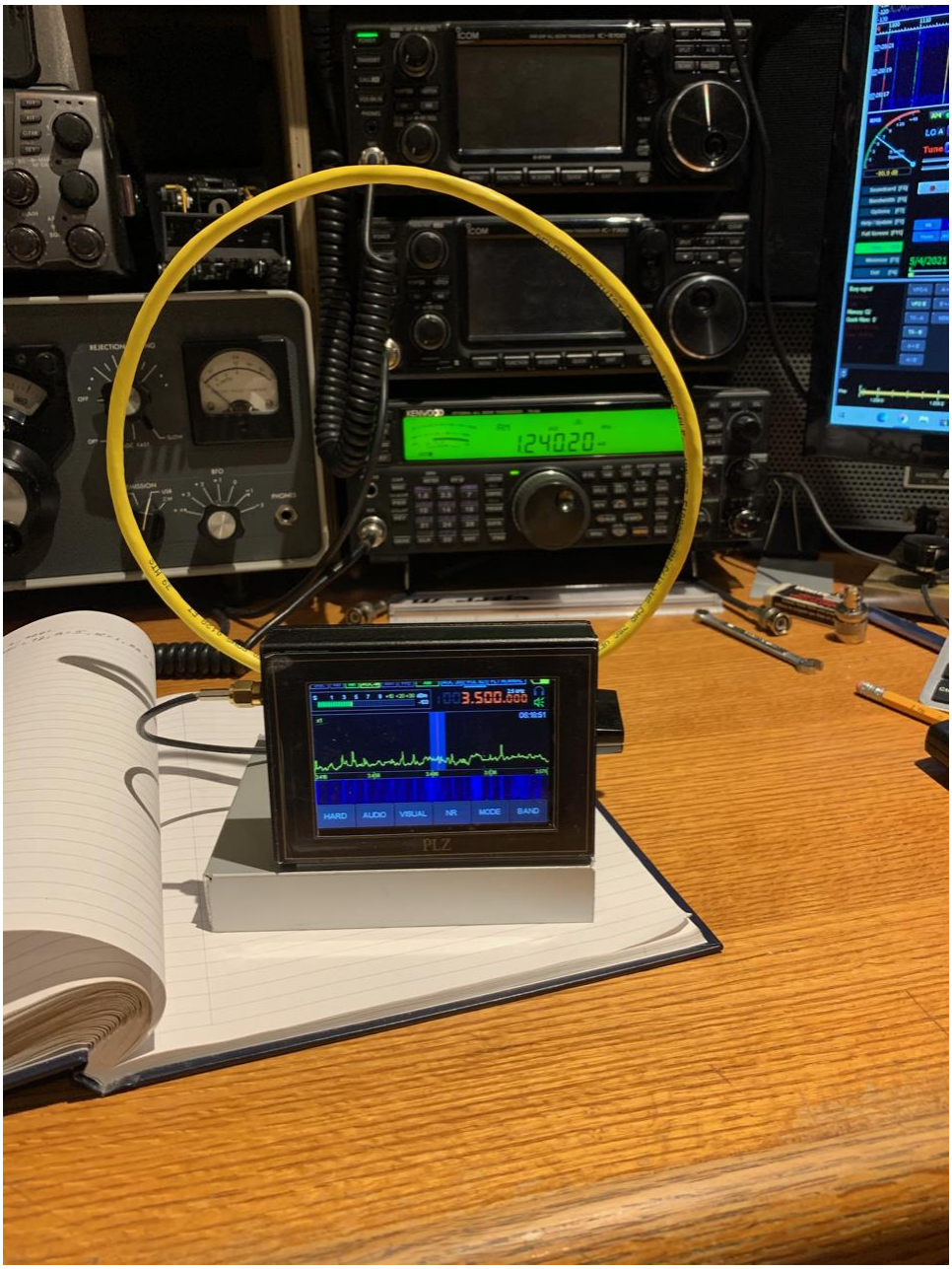
Finding Interference With a Loop:

Last year about this time I bought a little receiver on the internet from somewhere in the Far East. It was called a Malachite and at the time was good from 50Khz to 200Khz with very limited features. A couple of months later when I had grown tired of it, I sent a note to Georgy Yatsuk RX9CIM asking how to upgrade this little device to its full function. George got back to me literally within minutes from Russia and sent me the information on how to do the upgrade and I paid for the license and away it went. We are talking about a little receiver that covers from 50 Khz to 2000 Khz with all modes and features you would only find on much more expensive communications receivers. But enough of that…

As we all are aware there is more noise and interference on amateur radio these days than ever these days. The digital world and its incessant square waves have caused the noise floor to rise to unprecedented levels and often on the lower frequencies digital noise obscures the bands completely. After getting this little radio, I thought that it would be a great idea to turn it into noise finding receiver complete with all modes, bands, a spectrum band scope and waterfall display. It has all of this and as mentioned more features than enough including a very sensitive S meter circuit. If I could find a suitable antenna for it that was small enough and directional it would become an excellent device for sleuthing out noise problems for anyone that needs to.

The biggest problem was the antenna. I had tried an old radio loop from an abandoned stereo system, and it worked to some degree, and I also tried a loopstick (remember them?) and it worked a bit better, but I still wasn't getting what I wanted. A couple of weeks ago, I was thumbing through the ARRL Antenna Handbook and came across an article on an 80M Direction Finder using a loop and a sensing antenna to create a cardioid pattern. The article is in the September 2005 QST. I immediately looked it up and voila there was my answer. It was built with a six-inch diameter loop of 5 wires with a capacitor across it to resonate the antenna on 80M. So, I built the antenna part of it by stripping a scrap piece of CAT5 and using an old 365 pf variable I was able to get it to go from the bottom of the 80M band to nearly 10 Mhz. But here's the thing, I wanted to be able to go from the broadcast band to about 20 Mhz and by putting taps on the coil I was able to accomplish that. I simply put a short piece of RG-174 on the antenna and with a male SMA connector it worked like a charm. So that was the breadboard version.



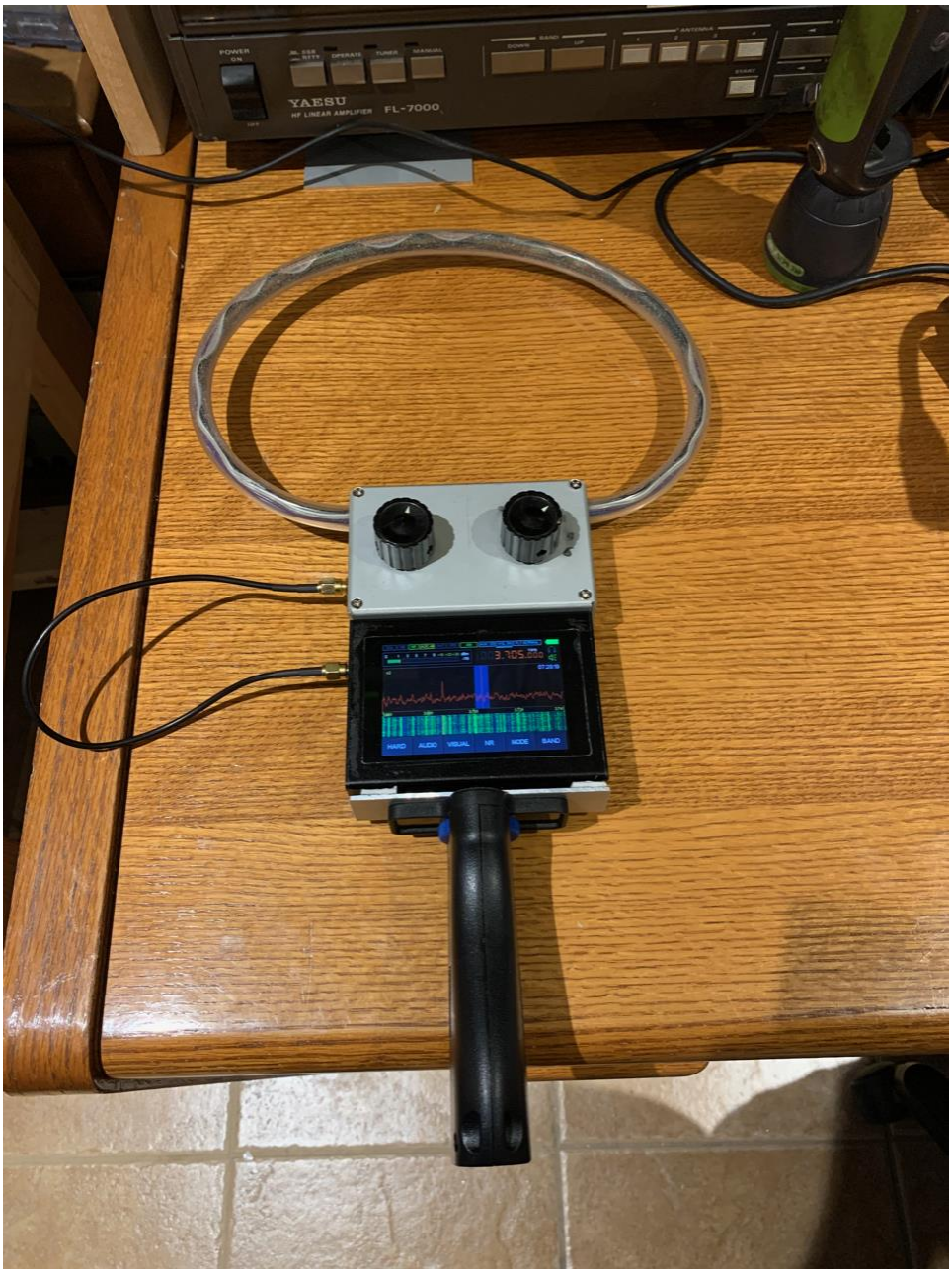
The breadboard version worked perfectly. You can see the tuning knob on the right side.

Now it was time to refine the thing to make it more useable in the field and portable. I bent up some aluminum into a box that had a section to stick the radio on to it and a chassis on the top to mount the switch and the capacitor as well as the antenna. An afternoon of bending up the box, doing the drilling, mounting the parts, wiring it and it was finished. It works perfectly. Because the capacitor needed to be isolated from the chassis, I mounted it off the back on a piece of Formica and attached it to the back of the chassis with some brass standoffs and 3mm screws. Here's what it looks like.

The final version with the little radio attached by foam spacers on it leaves the speaker open at the back for better sound.

The handle on the bottom was accommodated by drilling and tapping a 1/4-20 hole and attaching a photography handle that costs about $15 on Amazon. So how does it work? Very well indeed. I have not put the sense antenna on it yet which is required

to provide a cardioid pattern instead of a figure 8 but that will come in time. I'm also going to have it able to be tuned by using some varactors and a pot instead of the bread slicer 365 pf variable.



By holding the device at arms length and turning it so that the loop is facing the noise source you can get a deep null identifying its direction. I have found several sources of local noise that are now identified and have been reported to Industry Canada and Fortis.

If you want more details on this little device, look up the article in QST. It's included in the Antenna Handbook on the DVD that's included with it or you can ask ARRL for the article. The whole thing started off a few years ago when I wanted something to look for interference with and with constant digging, I found the solution. If you want a demo, just give me a call and we can do a Zoom call if you like.

73
Tom VE6ARG

Finding Interference With a Loop: Follow up

Last weeks' article on the little interference loop receiver project has generated a lot of interest from hams all over North America. Most want to build the little thing and one group has asked me to do a Zoom presentation on how to do so. I agreed and am working on version II of this neat little device with some refinements. The work will continue, and I promise to update you all on the progress as it develops. I want to thank everyone that has commented on it and inquired about building it. I appreciate the feedback.

73
Tom VE6ARG

Finding Interference With a Loop: (Another Followup)

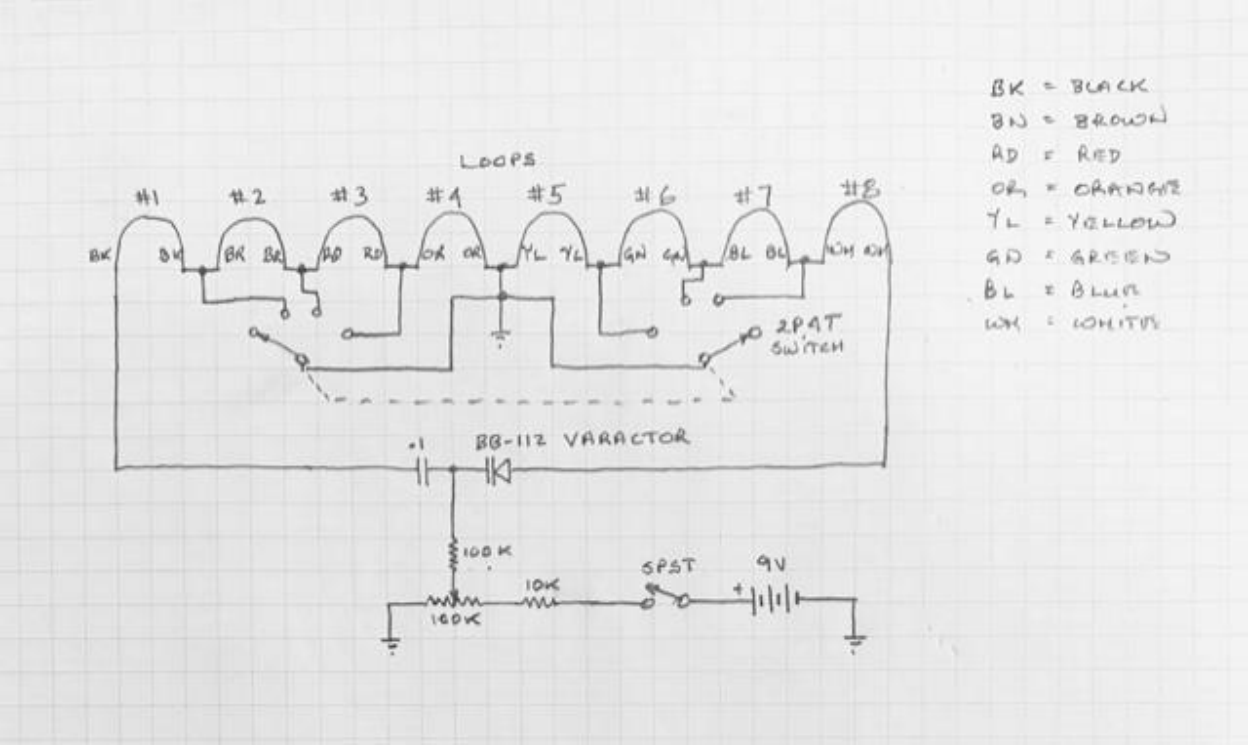
A couple of weeks ago I sent out an article on a little device I built around the Malachite radio. The Malachite radio was invented by three Russian hams and a bunch of clones are being sold through Amazon and other outlets like Aliexpress and Ebay for very reasonable prices. However I caution you that the device comes as either a limited function 200 Mhz machine or a fully functional communications receiver that covers up to 2 Ghz. /The 200 Mhz one can be upgraded for about $70 CDN or $50 USD. It is worth the effort and expense so get the more expensive one as the basic one is little more than a kids toy and will not be suitable for this project. The radio itself contains an interactive touchscreen that quite frankly is as annoying as those first touchscreens on cellphones back a decade ago. It is insensitive and takes a special "touch" to get it to work properly. Regardless, it works and I have successfully incorporated it into an interference sniffing device that is great at finding interference but just plain works. I incorporated a variation of an 80M direction finding radio that was originally published in the ARRL QST in October of 2005.

Now, as you might remember from the original article, last week, the most troublesome component to both source and employ was a 365 pfd variable bread slicer capacitor. Currently you can find them from a couple of sources but cost about $40 USD. Choke! I'm sorry, but we are ham radio operators and if you look up the definition of hams in your handy Funk and Wagnall's dictionary, it is a synonym for "Cheap". So something else had to be done to tune that antenna to resonance.

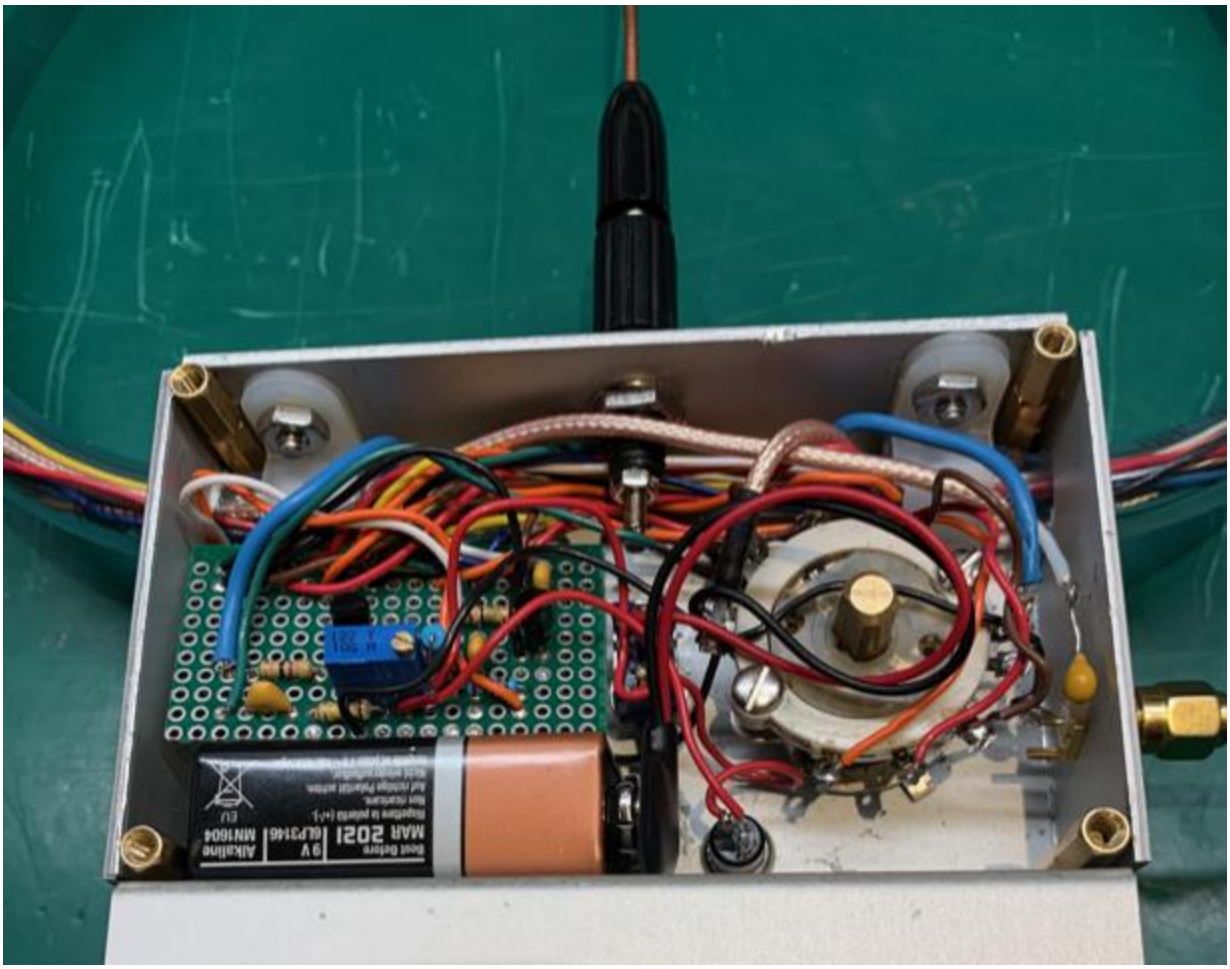
I started looking through my junk boxes for a bunch of varicaps (electronically tunable diodes) that I knew I had. I searched for days looking for the damn things and was unsuccessful in finding them so I ordered 50 more from China at a great price of about $1 each. A day after ordering them, Murphy raised his ugly head and I found

the correct bin box of one hundred 600 pF varicaps I had lost. Like an idiot I had labeled the box “Varactors” instead of Varicaps. How stupid of me. So, I had the components that I needed to complete the project and with a couple of resistors, a 100K potentiometer and a blocking capacitor I created a better replacement for the expensive and delicate 365 pF variable. It covers from 25 - 566 pF by varying the voltage applied to it from 1 volt to 8 volts DC. By switching how many coils on the antenna I use it allows me to tune the device even further down into the broadcast band. It is simple to use and works perfectly.

So below you see the schematic of what I created so that the device will tune from 1 kHz to 25 mHz using the switch to select how many of the loops are being used. It isn’t perfect but it works for the purposes I have devised. How well and what Q you get depends on the reactance’s of the tuned circuits. Remember the higher the reactance the higher the Q as long as you keep the resistance low. That simply means that when the reactance of the circuit is low the Q is going to be low as well. So, for instance if you are using only three of the loops which has an inductance of about 10 uH then at 25 pF it tunes approximately 10 mHz with a reactance of 600 ohms. If you move to the other end of the tuning range of 500 pF then the frequency is going to be



around 2.2 mHz with a reactance around 150 ohms. Not going to be as sharp at that point as you can see. However, it is plenty sharp enough to get a peak on the signal and it will work fine.



As you can see from the schematic the eight individual wires that are threaded through the 18” piece of plastic tubing from one end to the other form the loops antenna all terminate on a small piece of proto board and are connected in series with each other to form the entire loop antenna. There are other parts to it that are not shown on the schematic that form the sensor loop for the radio made of a piece of RG316 coax and another blue wire that forms the feed loop for the sense antenna that I’m still perfecting. The sense antenna is only six inches long and that is the black banana plug on the top of the case. Other parts of the sense antenna circuit are the blue pot and other components on that proto board. I will describe those in a later update. You will notice the simple circuit that forms the variable capacitor with the BB-112 Varactor across the entire loop that has its individual sections shorted out by the DP4T switch. By the way it works perfectly and with the inductances of each loop in the series equals 45 uh across the whole thing which with 588 pfd equals a frequency of 978 kHz with a reactance of about 300 ohms, so pretty sharp. Remember all those amazing formulae from your radio courses that you thought you wouldn’t have any use for after passing your exams? By the way if you

are wondering why it is grounded in the middle of the antenna it is because it is a balanced antenna loop which makes it very directional. When you orient the station you are wanting to hear end on to the signal it will peak, but when you hold the loop flat towards the signal it will create a sharp null and you will know the direction is either before you or behind you. That's how loop antennas work and why they are so useful.

Ok that's enough for now. As soon as I have finished all the improvements to this little device you will get the rest of the article. Oh and by the way, if you want me to come out and demonstrate this little thing to find some interference for you, just send me a note and we will make an appointment.

73
Tom VE6ARG
