An HF Portable Antenna

Paul R. Jorgenson KE7HR NSS 39382FE

The need arose for a compact, cheap, antenna for the 75 meter HF amateur band to be used for cave radio communications. Full size antennas are a bit awkward at 75 meters. (The 75 or 80 meter amateur band in the USA extends from 3.5 to 4.0 MHz.) Good success was seen with a MFJ 1988T portable telescoping antenna. This base loaded antenna costs about $129 USD and is usable on 80 to 10 meters. I wondered how hard it would be to homebrew a single band antenna for 75 meters to work with my low power single band radios.

Radio Shack (US) had some telescoping replacement antennas on sale. I picked up a model 270-1408B that extends to 6 feet (1.82 meters) and collapsed is about 14 inches (.35 meter). This seemed like a good starting point. Other items that I had were 1/2 inch schedule 40 PVC water pipe, a panel mount BNC connector, and #22 solid insulated wire. Now it was time to put it together.

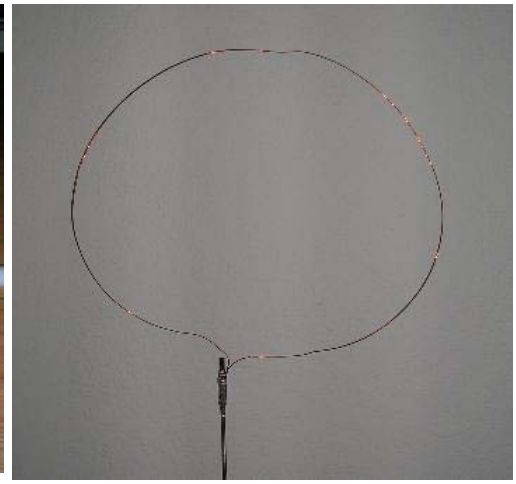
I did not want to make the loading coil too much longer than the telescoping section. I close wound the #22 wire on the pipe for a distance of about 18 inches (.455 meter). The winding turns out to have 82 uH of inductance as measured by my BK 878 meter. Attaching the telescoping section to the pipe (while inside my house) gave success. Varying the length of the telescoping section was obviously changing the resonant point and the signal strength was good. I wrapped the coil section with white electrical tape. The screws that I used to mount the BNC to the pipe were long enough to have a wing nut on the back side. This easily allows the attachment of a counterpoise, which is needed. The recommendation from MFJ is to use a counterpoise that is calculated using (180/F MHz). This works out to about 50 feet (15.2 meters) at the 75 meter band segment.

Now time to take it outside and make it play with the radio. Setting up was disappointing - I could not get the antenna to resonate. My initial testing inside the house apparently had the effect of adding capacitance to the circuit. I found that the resonant point with the full extent of the telescoping section was about 3.9 MHz - 400 KHz too high for the digital segment of the band meaning the antenna was too short. I clipped a section of wire to the top of the antenna and could get it to resonate down in the 3.5 MHz range. Searching around in the garage for ideas, I came across a piece of aluminum tubing that the telescoping section would fit into without too much slop. A few taps of the hammer and it was quite snug. A 20 inch (.51 meter) section of the tubing was cut. I flattened one end to attach to the top of the PVC pipe and drilled a hole to secure the telescoping section at the top. Now I had more than enough length and the antenna would resonate all across the 80 meter ham band.

Tuning is initially accomplished by changing the length the telescoping section a small amount at a time while listening for an increase in signal strength. Fine tuning can be done with a SWR meter and the transmitter on low power. Don't touch the antenna while transmitting! Not only will it be detuned, but a RF burn will be your reward! I have been able to get a 1:1 SWR all across the band. I have run as much as 15 watts power to this antenna with no visible ill effects, but expect that it is just a QRP or low power antenna.

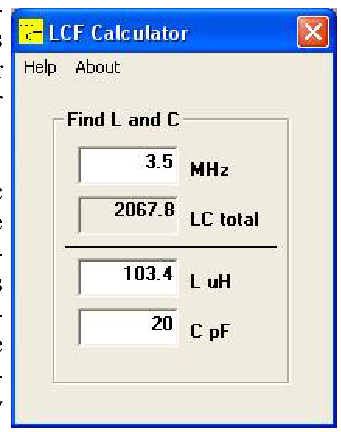
(Continued on page 18)

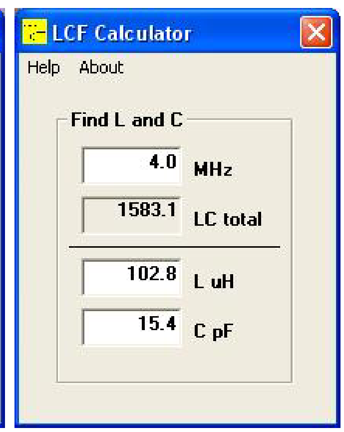
(Continued from page 17)



To support the antenna, more PVC comes to the rescue. I cut three lengths of pipe about 12 inches (.3 meter) and one length about 1 inch (3 cm) long. A purpose built, $5, PVC pipe cutter is far superior to using a hacksaw for making accurate and clean cuts. These lengths are placed in a 4 way PVC connector. The shortest length has a 90 degree connector that the bottom of the antenna pipe sticks into. Not gluing the pieces allows angle adjustment for uneven ground. The whole package collapses together nicely and fits easily into my pack. I tie the pieces together with hook and loop fasteners that are two sided. $10 in parts for a portable antenna. This is one of the antennas that was demonstrated at the 2005 Convention Radio Field Day.

Before building another version, I wrote two computer programs (LCF Calculator and Coil Calculator) to help model the antenna circuit and allow other designs to be considered. The antenna circuit appears as a resonant circuit with a direct relationship between the Frequency, Capacitance, and Inductance. Since I measured the inductance of my first coil at 82uH, and the resonant point of the non-extended pull out antenna section was 3.9 MHz, then the pull out antenna had to be acting as a 20 pF capacitor. Reducing the length of the pull out sections reduces the capacitance. Since the maximum capacitance of the pull out section was now calculated, changing the design was a matter of trying other combinations of coil size and wire diameter (and insulation) for the inductance portion of the antenna.





I have built several other versions of the antenna using both plastic insulated wire and enamel covered magnet wire. I have also gone to more available, more robust, stainless steel replacement antennas from the auto parts store. A couple of the design examples is given by screen shots of the design programs. The smallest example was made with #20 magnet wire on 1/2 inch PVC, making the coil only 4 inches long. This extreme example had trouble resonating with the pull out antenna section and needed a "capacity hat" or coil of wire at the top to get the SWR to a reasonable value.

A tuner is required to effectively work underground since the passage size and other variables tend to detune the antenna. A very small QRP (low power) tuner made from poly variable capacitors and a tapped coil wound on a torrid has worked very well and is small enough to fit in the cave pack.