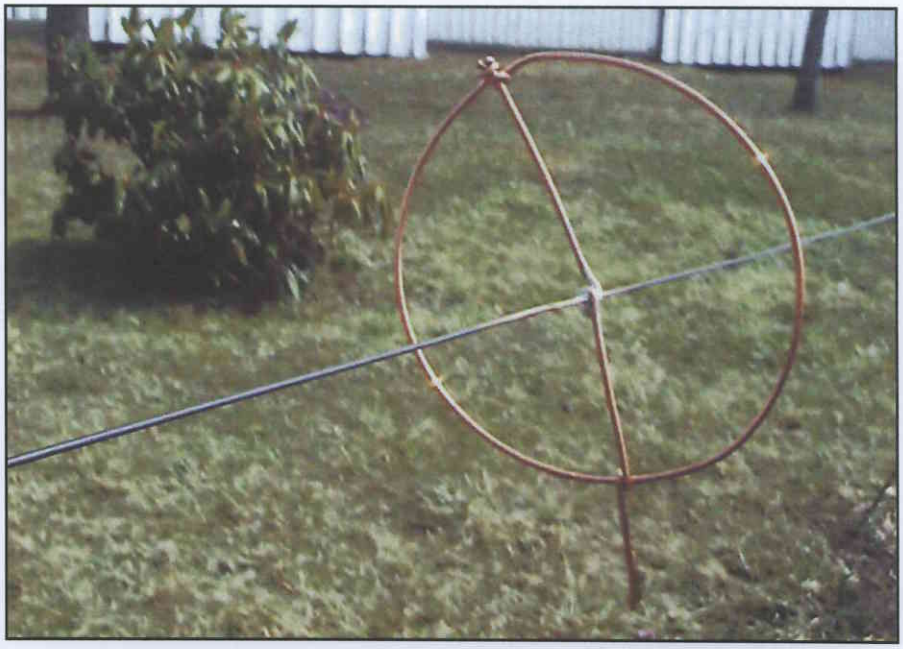
By Sylvia Hutchinson, K8SYL

K8SYL's 75 and 10-Meter Dipole

On getting licensed, upgrading and entering the wide world of HF.



In June 2000, I retired after 36 years of teaching and moved from Connecticut to my native state of Michigan. At first, my days were completely consumed with getting settled into our house and working around the lawn and gardens. It wasn't easy, but it was fun.

As Labor Day approached, I had the feeling that it was time to get ready for school. The outdoor work, while not over, was under control. I had time for me, and because I wouldn't be teaching I decided to be the student.

Chuck, K8CH, had received his first ham license while we were still dating. Back then, I learned a phrase in Morse code because he would tap it out on my hand during church. Even today, I can recognize "I love you honey" at 25 wpm but I'm not sure if I'd recognize my own call sign at that speed. A few years later, I remember sitting in a school gymnasium with my husband of nearly a year as he handled messages for the Red Cross. It was interesting, but it wasn't for me—not then. I was a full-time student at Michigan State University, and my first son was on the way.

For 40 years I had watched Chuck enjoy operating his radio, and I knew he would like to share that with me. I too wanted to share it with him. It looked like fun, and now I finally had the time for Amateur Radio. Being a wife, mother and bilingual (Spanish) special-education teacher had been very demanding of my time. I decided to go for my Technician class license. We had a copy of *Now You're Talking!* on the bookshelf.[1] I spent about an hour a day studying, and in the process set the goal of achieving 100% on the exam.

In February 2001, I met my goal, passing the exam with a perfect score. (Thanks, HQ staff who wrote the book!) The first thing I did as a new ham was to send my money and application for life membership in ARRL. The second was to apply for a vanity call sign. I didn't want to be KC8QKB if I could be, say, K8SYL. Then I checked into the Ionia County ARES (ICARES) net on the N8ZMT repeater in Portland, Michigan. That's something I continue to do regularly. I had met these folks at their monthly Saturday morning breakfast meetings. They were all supportive and made me feel welcome.

One of the ICARES group is long-time family friend Donna Burch, W8QOY. As soon as I had that Technician class license, she and Myriam Gregg, K8ILN, began to encourage me to upgrade to General. I would have 75-meter privileges and could join The Auto State YL Net (TASYLs). That sounded like fun and besides I was ready to learn more code than "I love you honey."

Time to study for that General. Back to the books, this time *The ARRL General Class License Manual*.[2] I set the same 100% goal for the written exam as before, and thanks again to Larry, WR1B, and the ARRL HQ staff, I reached that goal.

I had learned the Morse characters a long time before, but now I needed to relearn the characters and build some proficiency. Chuck downloaded the program *Morse Academy* from the Internet and I got started. Soon after, we ordered *Morse Tutor Gold* software from ARRL and that became my favorite learning tool. Once my code speed began to approach 5 wpm, I started using W1AW code practice. I particularly liked the *Real Audio* files available online at: **www.arrl.org/w1aw/morse.html**. Those files allowed me to listen at my convenience. For other code learning ideas check out **www.arrl.org/FandES/ead/learncw/** on *ARRLWeb*.

My First HF Antenna

With my new General class license about to arrive, I wanted antennas for 75 and 10 meters. With help from Chuck, I put together a 120-foot center-fed dipole and we installed it about 35 feet high. This allowed me to join the other members of the TASYLs on their weekly 75 meter (3940 kHz) net. With leg lengths of 60 feet, my dipole was resonant at 3.900 MHz and the 2:1 SWR points were at 3.830 and 3.980; see Figure 1. It was good enough for my purposes, so we didn't bother pruning it further.

I was doing very well on 75 meters, but what was I to do for 10? Chuck had a

[1]Notes appear on page 34.

partially built 10-meter ground-plane antenna in the basement that he was building for the book he was writing.[3] That was nice, but that ground plane wasn't going to do me much good until it was finished and he was working on other chapters. I wasn't going to wait. One afternoon I was tuning across the 10-meter band when I heard KP4NU calling CQ from Caguas, Puerto Rico. I really wanted to have a QSO in Spanish, so I did what you would probably do—I called José using my 75-meter dipole (after first engaging the internal antenna tuner in my transceiver). I had a nice QSO. Was it luck, good conditions or what? After I bragged about my contact, I asked Chuck what he thought about it.

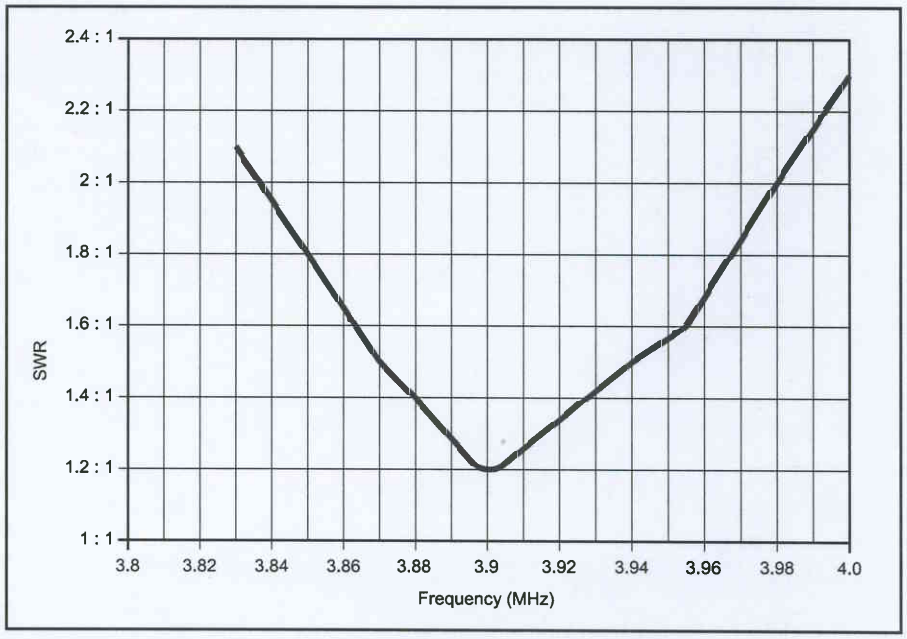


Figure 1—SWR of K8SYL's original 75-meter dipole with 60-foot legs.

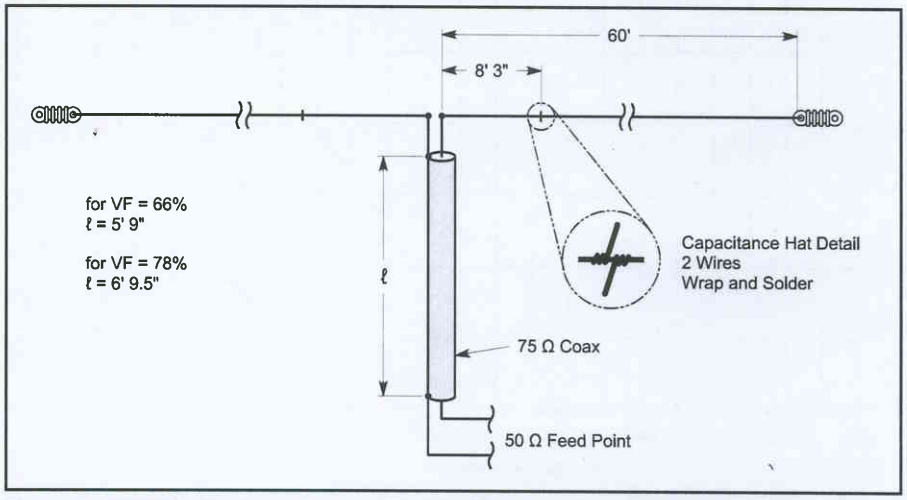


Figure 2—K8SYL's dipole as first modified for 75 and 10-meter operation. A quarter-wave section of 75-Ω coax transforms the 10-meter impedance. Capacitance hat wires wrap securely around the dipole and are soldered. They extend about 5 inches from the main dipole wire. See text for tuning instructions and final dimensions. This drawing is not to scale.

The Explanation

We both knew that a dipole is resonant on odd harmonics (3rd, 5th, 7th, etc), but 28 MHz is 8 times 3.5 MHz. That's true, but my dipole is cut for the high end of the band—closer to 4 MHz. Hmm, 4 times 7 is 28, and harmonic resonance is higher than one would expect. In other words, while you might expect that a 75-meter antenna that is resonant at 3940 kHz would have a 7th harmonic resonance at 27.58 MHz, it will actually be over a MHz higher.

We both understood the theory, but to better answer my questions Chuck next connected our MFJ-259B analyzer to the antenna feed line. The analyzer showed a resonance just below 29 MHz with an SWR of less than 3:1. He then modeled my antenna in *EZNEC*, which confirmed what the analyzer had just shown. At this point there were two options. The first was to leave well enough alone and use the transceiver's automatic antenna tuner.

The second option was to make my 75-meter antenna usable on 10 meters without the need of an antenna tuner. That's what we opted to do.

The Design

We had to deal with two issues in order to use my dipole on 10 meters. The first was to improve the 10-meter match without upsetting 75-meter operation. The second was to move the dipole's 10-meter resonance point a bit lower in the band.

At resonance on 10 meters, the feedpoint impedance is about 120 Ω. We used a calculator to confirm that a quarter-wave transformer made with 75-Ω coax would take care of the 10-meter impedance match. At the same time, the length of this coaxial transformer is short enough to have no significant effect on the antenna's 75-meter operation.

I used RG-11 to build the series-matching transformer. For low-power operation, RG-59 can substitute. The physical length of the stub depends on the velocity factor. My RG-11 (Belden 8238) has a 66% velocity factor, which means the stub is 5 feet, 9 inches long. If you use 75-Ω coax with a 78% velocity factor such as Belden 8213 or 8212, you'll need to make your stub 6 feet, 9.5 inches long.

I had built my antenna to cover the upper (General class) end of the 75-meter band. Chuck and I thought about lengthening the dipole to move 10-meter resonance to the vicinity of 28.4 MHz. The *EZNEC* model said it would only require 4.5-inch extensions to each dipole leg. The downside to this is that it moves the 75-meter resonance to 3.89 MHz, and that's lower than what I wanted. I asked if we could find a method to lower the 10-meter resonance without substantially moving the 75-meter resonant frequency? Chuck had an affirmative answer.

He told me that Rus Healy had described adding capacitance hats on a 40-meter dipole to move the 3rd harmonic resonance lower in the 15-meter band.[4] We could use a similar technique to lower the 7th harmonic resonance of the 75-meter dipole. In the case of my antenna, *EZNEC* indicated that it took only the little bit of loading provided by a pair of short (3-inch) wires on each leg of the dipole. We modified my 75-meter dipole as shown in Figure 2. It was easy, and tune-up went smoothly.

Tuning the Antenna

First I'm going to explain the process to follow in tuning this two-band dipole. Then I'll tell you how it worked for me.

With the 75-Ω quarter-wave transformer section in place, tune the antenna for resonance in the upper part of the 75-meter band. As I found out through experience, you should do your tuning with the antenna in its final position. You'll need to trim for best SWR above about 3.89 MHz or you're apt to lose some 10-meter coverage. If you tune for about 3.925 MHz, you should cover the entire General class band of 3.850 to 4.000 MHz with an SWR of 2:1 or better.

Next, check the 10-meter resonant frequency. (For the dipole dimensions given in Figure 2, it was just below 29 MHz.) If you need to lower that frequency, add the capacitance hats as shown in the drawing. You may want to make the wires a bit longer to start with. Check the resonant frequency again—it will be lower. To raise the frequency you can trim the fingers of the capacitance hat or you can just bend them a bit. It's that easy—at least in theory.

Chuck used the support mast for my dipole to hold a 2-element 17-meter Yagi (a project for his book). That meant we had to move my dipole, and it ended up being only 28 feet above the ground. Between that move and the addition of the 75-Ω quarter-wave transformer, my dipole's 75-meter resonant frequency shifted another 20 kHz lower. To compensate, I ended up shortening each leg by 8 inches, making the leg lengths 59 feet 4 inches. This gave me an SWR of 2:1 or better across the entire General class portion of the 75-meter band (see Figure 3).

As you might guess, that raised the 10-meter resonant frequency so that the simple loading wires were not sufficient to give me good SWR at the lower end of the band. I used a couple of 16-inch lengths of bare copper wire to make capacitance hats. I formed these into circles by wrapping them around a piece of 4-inch PVC drainpipe. I then fastened and soldered the circles to the loading wires as shown in the title photo. As you can see, I didn't bother to trim the extra loading wire. This gave me coverage of 28 to 29.1 MHz with an SWR of 2:1 or better, as you can see in Figure 4.

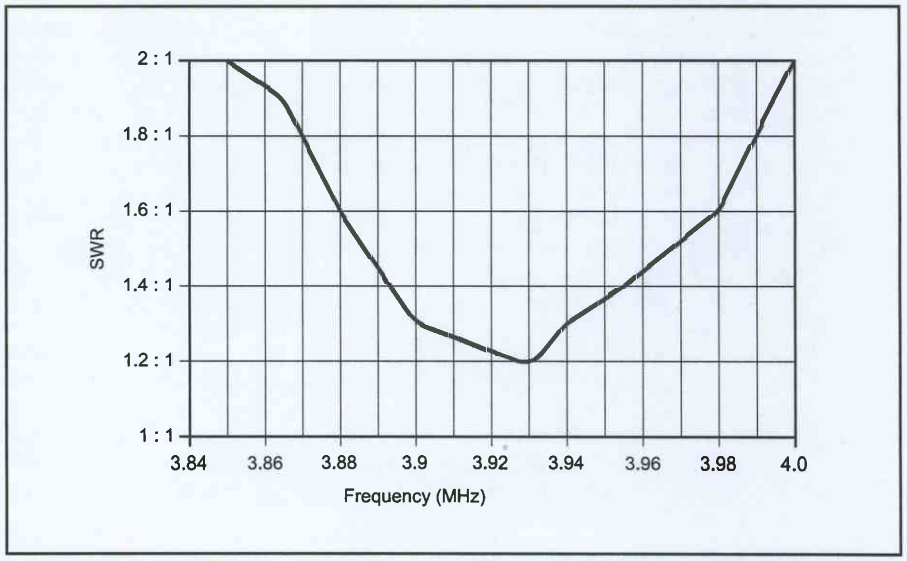


Figure 3—SWR of the modified K8SYL dipole after the two legs have been shortened to 59 feet 4 inches. The dipole now covers the entire General class portion of the 75-meter band with an SWR of 2:1 or better.

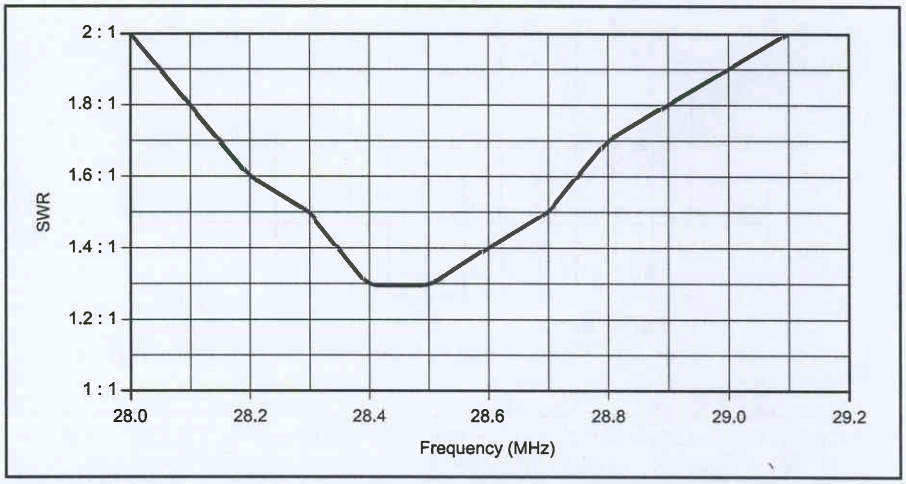


Figure 4—SWR of the K8SYL dipole covers over 1 MHz of the 10-meter band with an SWR of 2:1 or better. If you operate CW, you may want to lower the 10-meter resonant frequency by adding a bit more loading with larger capacitance hats.

The Results

I have been using my dual-band dipole for nearly a year with very good results. I make 75-meter contacts with ease. Okay, I don't chase exotic DX, but I have no trouble talking with my friends. On 10 meters, I'm able to make contact with the US and most of the world. Amateur Radio is really fun!

In case you're wondering, Chuck completed that 10-meter ground-plane antenna shortly after we finished this project. In head-to-head comparisons, sometimes his ground plane works better, and sometimes my dipole comes out ahead. The reason for that is wrapped up in the antenna patterns and angle of arrival of the signals. I could show you the theoretical patterns of our antennas, but you will probably put yours up in a different configuration. The point for telling you this is to let you know that it's always good to have a choice between antennas—especially when you're talking about simple antennas like dipoles and verticals.

Around here, we're pretty much convinced that my dipole has become a permanent fixture in our ham station. I'd like to get up it a bit higher for better 75-meter performance, but it works very well on 10 meters. Perhaps this is what you should try for your next (or first) HF antenna.

Notes

[1]L. Wolfgang and J. Kleinman, *Now You're Talking!*, ARRL, Newington, CT, 2000.
[2]L. Wolfgang, *The ARRL General Class License Manual*, ARRL, Newington, CT, 2000.
[3]C. Hutchinson and R. D. Straw, *Simple and Fun Antennas for Hams*, ARRL, Newington, CT, 2002.
[4]J. W. (Rus) Healy, *Antenna Here is a Dipole*, *QST*, Jun 1991, pp 23-26.

In addition to Amateur Radio, the author enjoys reading, gardening and spending time with family—especially her granddaughter, Briana. You can contact Sylvia at 9145 Bliss Rd, Lake Odessa, MI 48849; **k8syl@starband.net.**