Simpler Hardware Methods for iCW
with the Amazing Hi-Per-Mite Bandpass Filter

Joe Loposzko, KF7CX

pulp

This article will show you how little it takes to use hardware methods to generate tones for Internet; CW (iCW) operation. A hardware method might be of interest to those who don't like the idea of using computer programs such as CWTYPE or FLDIGI for iCW. The two examples that will be presented use the Hi-Per-Mite audio filter (pictured above) to achieve results that are superior to what I

obtained with the circuitry described in my previous article *Operating iCW with a Sine Wave Oscillator* (see iCW Google site). The intent of this article is to provide information that may inspire others to experiment with the Hi-Per-Mite.

Some Background

As explained in my previous article, a good hardware solution for iCW may not be as simple as connecting a sine wave oscillator to a computer sound card input. In many cases, the experimenter maIy encounter problems with key clicks, low frequency thumping, and unpleasant harmonics. In my case, I was able to overcome the key click problem by keying a sine wave oscillator that generated waveforms with the required rise and fall times. To reduce the level of low frequency components and harmonics, I connected the output of the sine wave oscillator to a W3NQN passive audio filter (Figure 1). The output of the filter was then connected to the sound card input.

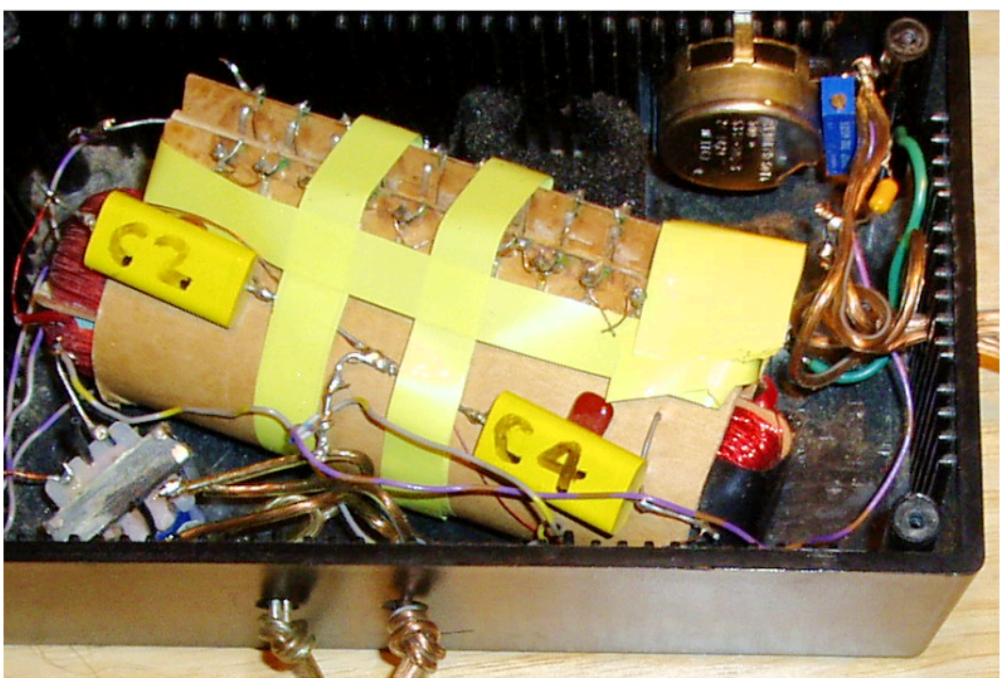

Figure 1. W3NQN passive audio filter

This method of generating tones for iCW worked reasonably well, but my CW had a bit of ringing caused by both the oscillator circuit and the filter. In addition, my keying sounded like it was being affected by excessive filtering. Being aware of these deficiencies, I kept searching for better methods.

Around the time that I started using my sine wave oscillator method to operate iCW, Chuck, AA0HW, started experimenting with the W3NQN filter. In doing so, he showed that it was not really necessary to use a sine wave oscillator. He was able to obtain a good tone for iCW by filtering the square wave sidetone of his keyer with the W3NQN filter. He demonstrates this in his excellent video, *How to Send Morse Code Over the Internet on Windows 7: The Basic Setup*.

Last year, the Four State QRP Group (http://www.4sqrp.com/HiPerMite.php) started selling the Hi-Per-Mite audio filter. The Hi-Per-Mite offered a 700 Hz center frequency with a 200 Hz 3 dB bandwidth. Several of us were interested in finding out how this filter would perform on iCW. Compared to the W3NQN passive audio filter, the Hi-Per-Mite is much smaller and lighter.

Initial testing with the Hi-Per-Mite by Chuck, W5UXH, showed that the filter was very effective for iCW circuits. My own testing showed that the Hi-Per-Mite could convert the square wave of a keyer sidetone into a sine wave. It also shaped the rise and fall times of the dots and dashes without the need for additional circuitry. This meant that it could be as easy as connecting the square wave sidetone output of a keyer to a Hi-Per-Mite filter to produce a good tone for iCW.

Figure 2 is an example of what the Hi-Per-Mite can do. The oscilloscope display shows what happens when we key a dit from a square wave audio oscillator and filter it with the Hi-Per-Mite. The rise and fall times of the filtered output are approximately 5 ms instead of 0 ms that might be expected from the unshaped waveform entering the filter. More information about the Hi-Per-Mite can be found in AA0HW's 1 February 2013 blog posting:
 - *The Hi-Per-Mite Active Audio CW Bandpass Filter is Awesome* -

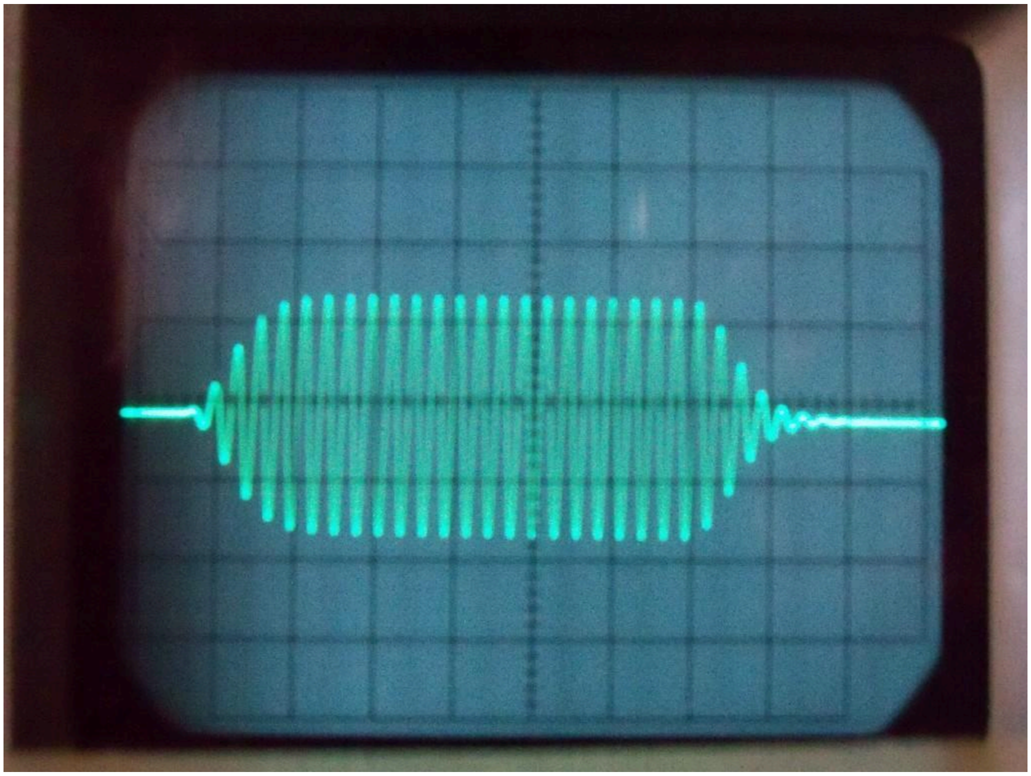

Figure 2. Dit from a square wave oscillator after being filtered by the Hi-Per-Mite

K1EL K40 with Hi-Per-Mite

The K1EL K40 CW Keyboard Keyer (Figure 3) is used by a number of keyboard CW operators and can be easily modified for iCW operation by using the Hi-Per-Mite.

Figure 3. K1EL K40

- As users of the K40 know, the keyer includes an audio frequency (AF) output that is normally used to drive the speaker of the internal sidetone. By connecting wires between the AF output and ground as shown in Figure 4, we can add iCW capability to the circuit. The Radio Shack audio transformer (273-1380) in the figure reduces the sidetone level so the Hi-Per-Mite output will be about 1.5 V_{p-p}. This level should work well when connected to the Line-In jack of most computer sound cards. Instead of using an audio transformer, the experimenter may prefer to use a potentiometer as a voltage divider to provide a suitable level for the input of the filter. This might be a better way of finding the appropriate level for use with the Mic-In jack of a sound card.

Figure 4. Configuration for using K40 AF output with Hi-Per-Mite

Ideally, the sidetone frequency of the K40 should match the 700 Hz center frequency of the filter. The K40, however, only allows the selection of several fixed frequencies, so this is not possible. Fortunately, the use of the 666 Hz sidetone frequency works very well with the 700 Hz Hi-Per-Mite. Figure 5 shows the spectrum obtained with this setup when sending a string of V's at 65 wpm. The peak actually occurs around 674 Hz. This result was obtained with the Hi-Per-Mite connected to a 9 volt source. This voltage level produced the best spectrum. At 5 volts, a fairly high peak was seen at the lower frequencies. I did not do any tests to determine if the difference is actually noticeable when just listening by ear, on iCW.

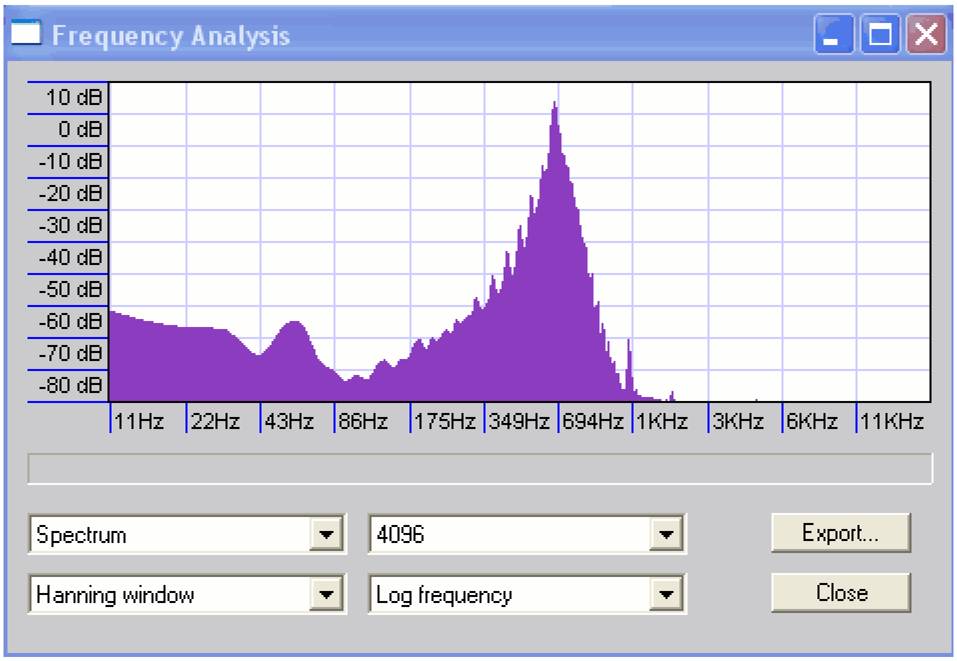

Figure 5. Audio spectrum of K1EL K40 with Hi-Per loo-Mite

The reader might be concerned that a filtered K40 would not allow for all types of iCW sending options. This, however, should not be the case based upon information in the K40 manual. In addition to keyboard and paddle keyer operation, the K40 allows for bug or straight key operation if the proper command is selected.

My iCW-Modified K40

Figure 6 shows how I modified my K40 keyer to include Hi-Per-Mite iCW circuitry. My K40 was packaged in a Radio Shack plastic box instead of the fancy enclosure shown in Figure 3. I was concerned that there would not be sufficient room for the Hi-Per-Mite, but the circuit board easily fit into one end of the box (top of picture). The back view of the box (Figure 7) shows that I added a sidetone switch. This allows the user to operate iCW without having to hear the sidetone from the internal speaker of the K40. The following link lets you hear how the this circuit sounds when operating iCW.

https://soundcloud.com/chaseology/k40-sidetone-filtered-by-hi

Figure 6. iCW circuitry added to K40 keyer

Figure 7. Back view of K40 keyer modified for iCW operation

Square Wave Oscillator with Hi-Per-Mite
Instead of using the sidetone from a keyer to generate the iCW tone, the user might prefer to key an oscillator that produces the tone. The circuit of Figure 8 does this by using a 555 timer in an astable multivibrator configuration.

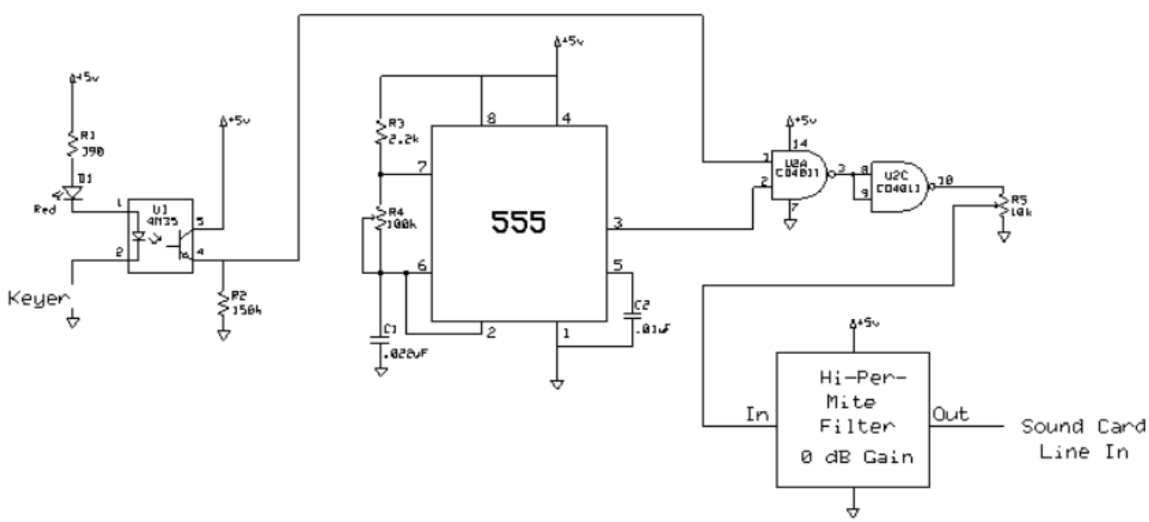

Figure 8. Simple square wave oscillator circuit with Hi-Per-Möter

In testing the 555 timer circuit, I first tried keying the timer by putting 5 volts at pin 4 during a key-down state. This produced a satisfactory iCW result for slower CW speeds, but a "percussive" sound was noticed at higher speeds. The solution was to let the timer circuit run continuously and key the output with a gate. I decided to use an optoisolator to provide 5 volts to the gate when keying the circuit. Other methods could certainly be used.

With this circuit, the adjustment of R4 can put the oscillator exactly at the 700 Hz center frequency of the Hi-Per-Mite filter. The resulting spectrum obtained with the oscillator and filter running from 5 volts is shown in Figure 9. As was the case with the K40 method, a filtered output level of about 1.5 $V_{p\text{-}p}$ produced a good level for the line input of my sound card. Adjustment of R5 to obtain a lower level might be needed for those who intend to use the circuit with the microphone input of their sound card. The following link lets you hear how the circuit sounds in iCW operation when keyed with the K40 keyer.

https://soundcloud.com/chaseology/555-timer-square-wave

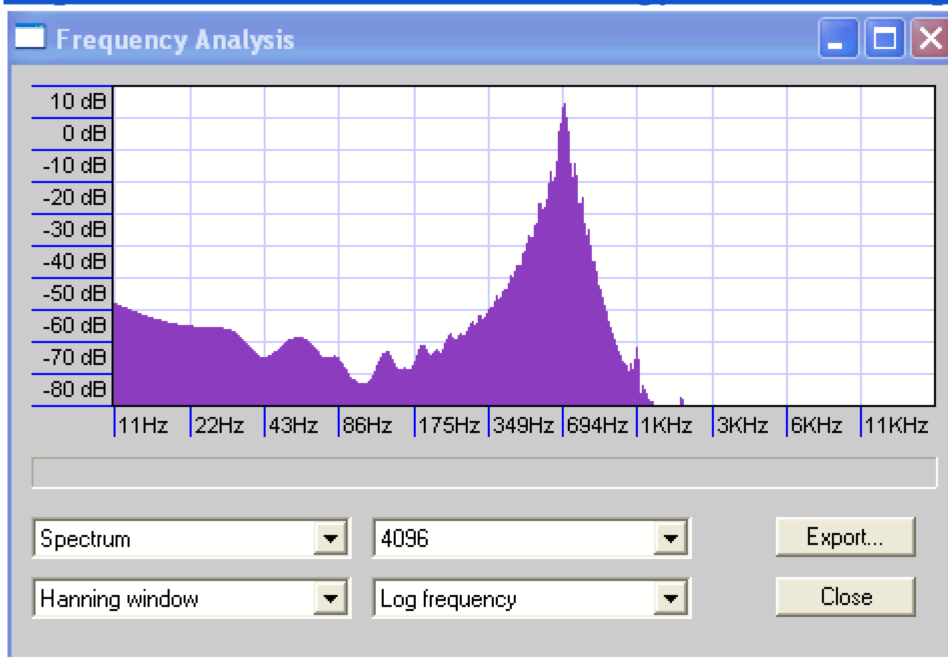

Figure 9. Audio spectrum of 555 timer oscillator with Hi-Per-Mite

Isolating the Sound Card

The circuits presented, do not use any isolation between the Hi-Per-Mite and the computer sound card. The experimenter may choose to use a Radio Shack 1:1 audio isolation transformer (273-1374), but this will usually produce some change to the audio spectrum. In most cases the level of some low frequency components and harmonics will increase slightly. These changes will probably not be significant in affecting the iCW sound.

Sound Card and Mumble Notes

After you get your iCW tone generator circuit working, you'll have to hook it up to your computer and try it on Mumble. Make sure that the tone output from the Hi-Per-Mite filter connects to the ring and tip of the plug going to the Line-In jack of the sound card. This allows the sidetone to be heard from both speakers.

I use only one sound card and select the same audio device for Play and Record on my Windows XP sound card software. With my computer, the Play Control slider of the Play Control panel controls the overall iCW receive level. The Line-In slider controls the level of the sidetone. On the Record Control panel, the Line-In slider controls the level of the transmitted iCW. In setting up Mumble, the same audio device is entered into the Audio Input and Audio Output setup screens.

The reader should view Chuck's "Basic Setup" video for detailed information on the sound card and Mumble setup. The video demonstrates how to set the proper transmit level by monitoring the level indicated on the meter of the Mumble Audio Input setup screen. Chuck also demonstrates the Loopback Test procedure that lets you hear how you sound on the server.

More iCW Projects Using Hi-Per-Mite

Chuck, W5UXH, has posted some interesting videos on YouTube of his iCW projects that use the Hi-Per-Mite. A good one to view is his iCW TeensyNr3 Keyer Demo (http://www.youtube.com/watch?v=72MkYz2qdTo) that shows his homebrew keyer nicely packaged with two Hi-Per-Mite filters. The second Hi-Per-Mite is used on receive to improve the copy of iCW signals. This is usually not needed, but it can be a nice feature to have at times.

Final Comments

Based upon my experimenting, the Hi-Per-Mite appears to be better than the W3NQN filter for iCW applications. The Hi-Per-Mite does not filter as sharply as the W3NQN filter and perhaps for that reason it allows the keying characteristics to come through better. This is particularly noticeable at higher sending speeds. The two hardware methods presented in this article produce better-sounding iCW than any of my previous efforts with sine wave oscillators and the W3NQN filter.