CWLab Version 04   *WN2A January 2008*   Build R1

Disclaimer: see Section 8 at end of this document**.**

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   Hardware Interfacing: See document CWLab04_Hardware.pdf

1.0 Introduction
   CWLab04 is a CW and CCW* Operating Program for the Amateur
Radio Operator.The program is written for Windows Xp operating
system. This version supercedes all previous versions, with many
additional features and enhancements. Some uses:
- Send (TX) and Receive (RX) both CW and CCW , with a type-ahead
   buffer
- Copy CW Bulletins/ Code Practice
- Monitor for CW and CCW activity/ Beacons
- Provide a "second op" during QSO's to provide "fills"
- To work well with simple homebrew CW equipment.

There are many options for the operator to select from. The program
itself is written in Labview 6.0i , with the Labview 6.0 Runtime Engine.
     * See Section 6.2 for explaination of program's CCW method.

2.0 System Requirements
 Minimum recommended system :
   CPU: Pentium 166MHz or better. Windows Xp Home or Pro versions.
   RAM: 32 Mbyte
   HDD: ~14 Meg available
   Soundcard: Windows XP compatible, SB16 Full or Half-duplex .
                 16 bit @ 8000 bit/sec.
               Used for RX as soundcard input and for
               TX as soundcard output for keying.

Software Installation:

2.1) Download file "CWLab04.pdf". Read it using Adobe Acrobat Reader and print it out.
Also download "CWLab04_Hardware.pdf" for interfacing info.
NOTE: Installation Procedure is changed so to allow for smaller size files, and
somewhat easier downloading.

Download "CWLab04R1.zip" and "CWLab04R1.z01" files into a temporary
folder on your HD (like C:\temp). Total Size: approx 15M.
Use WinZip (10.0+) and click on "CWLab04R1.zip file" to extract files
"SETUP.EXE" and "DATA.001". Save these to the same temporary folder,

i.e C: \temp.

(You can optionally delete these (4) four files in the temporary folder <u>later</u>,
after program installation)

2.2) Double-click on "SETUP.EXE". This will install program and support files into folder
C:\CWLab04, by default. Continue installation until "CWLab04R Installation was
successful". Click again to install Labview Runtime Engine 6.0. This will install itself,
then click "Finish". The installation program creates its own shortcut on the Start Menu.

Note   * On most PC's I have found that you can omit the following step <u>entirely</u>.
Only on one old PC was it needed. <u>Purely Optional</u>:

To setup soundcard for this program click on:
START>>Settings>>Control Panel>>Multimedia.
Click on the"Audio" tab on top. Under "Recording" click "Customize"
create an audio quality called "CW". At Format select "PCM",
Attributes select "8,000 Hz,16 Bit, Mono 16KB/s"
Name (where it may say "untitled") click on "Save As" ,
enter "CW" and click OK.

2.6 Click on CWLab04r icon (your shortcut) and the CWLab04 Setup Window
should appear (similar to fig 1).

Figure 1. SETUP Window
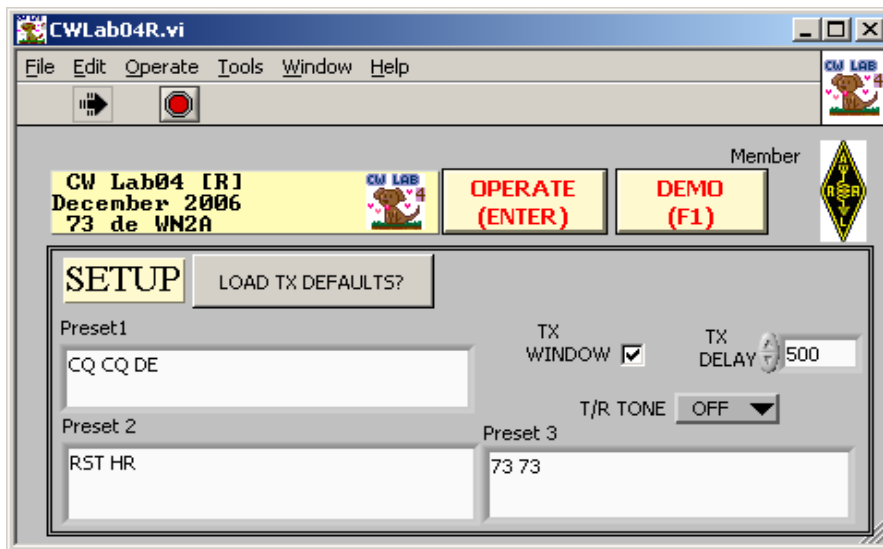
3.0 The Setup, RX Window, TX Window : Controls and Indicators.

The Setup Window appears each time you start CWLab04 . The program is not receiving at this point, it is waiting for you to make your initial choices and then click the "OK" button. Normally, if you may not need to make any changes once you have created your own TX preferences, just press OK (or Keyboard "Enter")

     TX WINDOW. Determines whether one wants to use CWLab04 for TX control or not. One option is to use program for RX only. You would use a key or keyer for transmit, if you prefer. TX WINDOW Default is on (checkmarked).

     TX DELAY : Sets the time delay from RX to TX. This allows your T/R relay to settle before keying is started.. Default is 500 milliseconds.

Preset 1,2 and 3: Three user-defined macros. Put in often used phrases here.

MODE: Selects normal operation (OP) or the use of wave files (DEMO). Cannot be changed later in program; you need to restart CWLab04 to change this.

The SETUP Window save your choices in a file named "my.dat" . If you want to return to the program defaults, just erase"my.dat" .

After you press OK, this SETUP Window goes into the background and the RX (and TX) Window(s) go on top. See Figure 2.

2.4) The SETUP window allows you to choose OPERATE or DEMO. Clicking "OPERATE" will run the program from the soundcard inputs , the "DEMO" gets its input from Wav files. TX operation is available on the "OP" mode. You can also elect to run only receive (RX) by unclicking the "TX Window".

Figure 2.   RX Window.
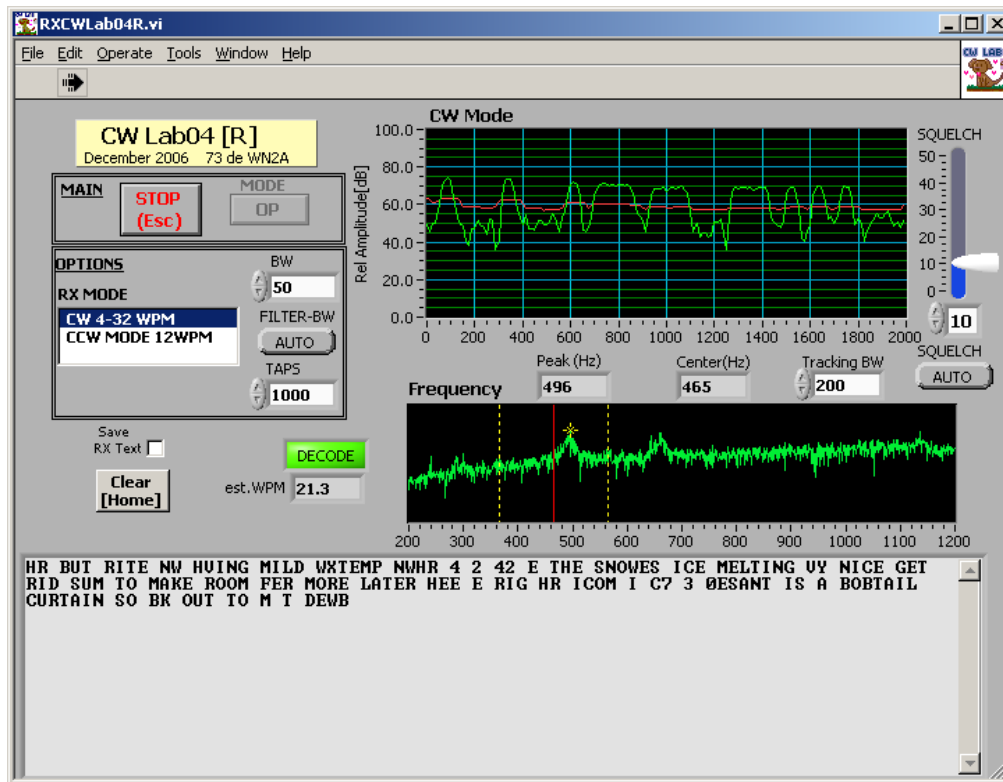
Here is a list of the RX Window Controls and Indicators with their functions:
       "MAIN" CONTROLS:
 "RUN ARROW".....Found at top left corner.Indicates window active running.
 "STOP" button........ halts program. Does not close it. To Close, Use File>>Close All.
"MODE" Indicator...is disabled and grayed out. Indicates "Demo" for reading CW/CCW
from a .wav file (see section 4) or"OP" for normal CW or CW/CCW operation from a
receiver (see section 5)

       "OPTIONS CONTROLS"
 "RX MODE" selects receiving mode, CW or CCW.
 "BW" ....selects Filter Bandwidth in Hz. "Auto" or "Manual" control for CW
                 and 12 Hz preset for CCW
"FILTER-BW"........selects "Auto" or "Manual" control
 "Order".................selects Filter Order (number of FIR TAPS). Default is 500. Can be
                 extended up to 2000.

       "WINDOW CONTROLS/ INDICATORS:"
"Save RX Text"...........Allows the RX Text to be saved in a text file.
"Clear".......................Clears the Text Window. "Home" is the keyboard shortcut.
 "estWPM"..................an estimate of senders rate.(estimated character speed) .
                 Generally displays speed if "DECODE" indicator is lit. Preset to 12
                 WPM in CCW. Max speed is 32WPM on CW.
 "Peak Freq"..............displays frequency with max signal within the tracking range.
 "Center Freq" ....displays center of tracking range (set by the "Frequency"
                 graph.
 "Tracking BW"..........selects range to track a CW signal, centered on "Frequency"
                 graph Red Cursor (see sections 4 and 5). Default is 200 Hz .

"Time Domain".......a graph that displays signal strength vs Time. The red line is the threshold. The threshold level can be modified slightly by the "SQUELCH" control.

"SQUELCH".............Basically a fine control of the threshold level. For weak CW signals and CCW a "SQUELCH" of 0-2 is recommended. Stronger signals do better with a setting of 5-10. Normally defaults to"Auto" Mode on CW .More on this later.

" Frequency "...........a graph that displays signal strength vs audio frequency. The red cursor line sets the center of the tracking range.You can change this to quickly acquire a signal and demodulate it. See Figure 3 for the detail . By moving your mouse cursor near the red line, the cursor changes. When it becomes a vertical bar with horizontal arrows, hold down the left mouse button and you will be able to move the center frequency around to acquire a signal.

"Text Display"..........The Receive text. Has a scrollbar. Compatible with cut-and-paste to a text editor.
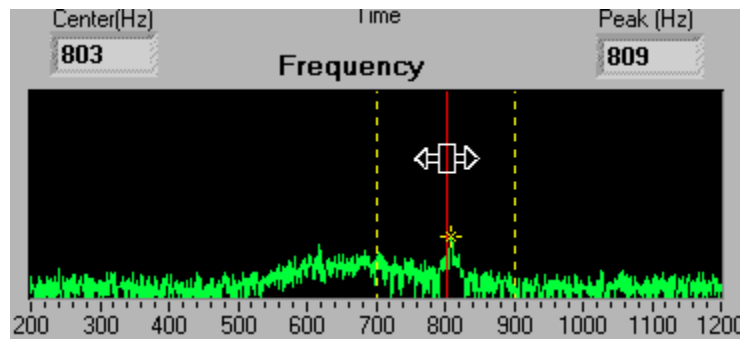
Figure 3. Frequency Graph

Figure 4.   TX Window.

TX Window Operation.

The program allows you to compose your sending text in the "TX Buffer" (White Box), while the RX function is still in operation. By pressing "SEND" (Keyboard Shortcut "Enter"), the receive function will continue, the T/R relay can be switched on (either via manual T/R control or LF tone-sensed, see CWLab04_Hardware.pdf), and the sending begins. As the transmission is progresses (or has been terminated), the text will have transferred up to the"Transmitted Text" (Gray Box).

Here is a list of the TX Area Controls and Indicators with their functions:
TX TONE : The sinewave frequency that will be sent to your TX mike input.
            Default is 800 Hz.
TX WPM : Default is 12 WPM (chosen for CCW).
TX LEVEL: A relative TX amplitude control. Default is 100.
"Preset1"; "Preset2";"Preset3" Recalls your macros set in Setup Window.
"TX Buffer" (White Box). Where you compose your message. Macros from the Presets
            get pasted here. You can backspace to delete, and cut and paste from
            other sources, even the RX Text Display!
"Transmitted Text" (Gray Box).That text that has been (or is being) sent.
"SEND"   Displays "RX" while you compose/receive. Click on it (or press Enter on
            keyboard) and "TX" will display. Your T/R switch can be commanded to TX (if
            enabled on Setup window) and sending starts, through the soundcard output.
          The sending will self-terminate at end of message OR when you click the SEND
          button again it (Keyboard Shortcut "Enter").
The three controls (TX TONE,TX WPM and TX LEVEL) can only be changed during receive. The program will save settings in "my.dat" at program termination.

    There may seem to be a lot to it, but actual operation becomes fairly simple.

4.0 Running Demo Mode.

The Demo mode allows the user to become familiar with the CWLab04 with just a PC. Any morse .wav file may be used, so long as it was recorded at 16Bit @ 8000 samples/sec, mono format. Some wave files are included of various messages at different S/N levels.

4.1   CW Demo #1 :

Start CWLab04 by selecting "DEMO"mode on the Setup Window. The RX Window will appear and you have to first select your wav file from the pop-up dialog box. Select   "WN2Abcn.wav"

You will have a few seconds to adjust your controls, if necessary:

> RX MODE   "CW 4- 32WPM"
> FILTER-BW   "AUTO"
> SQUELCH   "AUTO"
> TRACKING BW "200"
> FREQUENCY Graph approx 800 Hz (Not Critical)

The Time and Frequency displays will soon start, and the decoding of the wav file should then be displayed in the text display. With the cursors properly set, repeat this procedure and you should get near perfect copy (Fig 4)

Figure 4

NOTE: Before going to para 4.2, you may notice that the program stops when the demo is complete. Just go back to the SETUP Window and click the "Run Arrow" to restart, or to perform another demo.

4.2 CCW Demo#1 :

Now try the DEMO mode on another wav file, "SN-4N1L.wav" . This wav is much noisier than in para 4.1 but still can be tuned in and decoded with CCW 12 WPM. Good results were had with Frequency set for approx. 800Hz, squelch at 3. The appropriate CCW filters, etc will be automatically selected.

Figure 5

4.3 CCW Demo#2 :

Now try the DEMO mode on another wav file, "SN-6N3.wav" . This wav is noisier than in para 4.2 but still can yield good results. (Fig 6).

Figure 6

4.4 CW Demos #2 & #3. Try copying the wave files used in 4.2 and 4.3 , but with the RX MODE set to CW 4- 32WPM". Hmmm, not so good?? Looks like CCW works much better in noise than CW does. Is it better than your ear? That depends on the operator. It works about equal to me; maybe not as good as some of my friends with"DSP ears". The improved demodulation of CCW is due to synchronization.

5.0 On-The-Air CW/CCW Operating.

5.1   After running a few sessions in the DEMO mode, decoding CW/CCW from your receiver is straightforward. Connect the receiver audio output to either the microphone or line soundcard input using shielded microphone cable. Make sure your PC and receiver ground is the shield. While finding CW signals for Receiving is very easy, CCW is another matter. Hopefully, programs like this and others will change that.

5.2 Start the CWLab04 again and the SETUP window appears.Click on "OP" mode, The RX window should appear, and RX should begin. Tune your receiver until the desired signal(s) are within the Frequency display. On the Frequency display, adjust the vertical red-line cursor first for the desired signal peak (approximately) and your tracking range for how far you want this signal to be tracked. The text display should start. Adjusting SQUELCH in the "Manual" mode will allow the decoder to be less affected by noise, but the Auto" Mode is usually good for most copy. Note that the threshold level adjusts itself, depending on the signal and RX noise conditions. The SQUELCH then acts as a vernier in the manual mode.

5.3 If the senders speed is too high or if the senders timing is improperly weighted you may see "0" in the est.WPM indicator.

5.4 Once you have started running, and you may want to modify theOPTIONS: Noisy conditions can be remedied by adjusting BWand ORDER (except for CCW, which is preset). If the sending speed is slow enough even 5 or 10 Hz with an ORDER of 2000 is available but don't use too narrow a bandwidth or demodulation will suffer. The TrackingBW lets you modify the range the program looks for a peak.Wider is better for copying both sides of a QSO or a traffic net ; whereas narrow is better if you are trying to copy a weak station next to strong one. Finally, if the sender's speed changes, you can modify the Speed Range. If you need faster or slower try the appropriate range.

5.5   The Frequency graph cursor (red) needs only to be set roughly to the desired peak. The TrackingBW will set the range the program will look for a signal which is precisely indicated by a yellow "star".

5.6   The functions of the TX Window has already been explained in Para 3. It is relatively straightforward as to its use. The Operator is just alternating between using the RX and TX Windows during the course of a QSO. Just use the buttons in the Windows Xp taskbar (usually at the bottom of your display or wherever you set it)

5.7 Stopping the program: 1) In Receive use the STOP button on the RX Window
                                            2) In Transmit, Click the SEND button again(this should deactivate your T/R Switch) , then STOP Button on RX Window.

5.8 Close all Windows : Click on Menu: File>>Close All.

Don't expect copy as good as can be done by the ear/brain combination.
 On the other hand, this computer program does not fatigue easily.

6. Stray Notes:

6.1 Table of Keyboard Shortcuts:

Window	Control	Keystroke
SETUP	OK	Enter
RX	STOP	Esc
RX	Clear	Home
TX	Send	Enter (toggles)

6.2 Some Notes on this program's CCW demodulation:

In being perfectly clear (and honest) on what this program does on receiving CCW , the effort was placed on element synchronization, not in synchronizing with the audio tone. This is another way of saying that this is not true CCW detection , yet the program will detect CCW. One purpose of this program is to work well with simple homebrew (HB) CW equipment. After careful analysis of the output of some representative HB gear, it was found that these rigs did not produce an adequate phase coherent output! These transmitters were perfectly good sounding on the air, and both near and long-term stable, but the keyed elements lacked necessary phase stability. That coupled with the effects of propagation phase distortion that an acceptable signal one would see in the ionosphere convinced me to use non-coherent detection with element synchronization.
With only element synchronization, it seems to work adequately.

6.3 Some Notes on TX:

Since accurate timing is mandatory to make CCW work, it was decided to go with the Soundcard generated Morse. This appears to be a much better way to go than attempt to generate accurate timing through either the LPT or COM ports, especially in a Windows enviroment. So, to generate the keying, one just needs a Sound Card to Hard-Key CW circuit. Refer to CWLab04_Hardware.pdf .The SetupWindow values of TX Tone and TX level can be adjusted for this purpose.

7.0 Feedback/Acknowledgements ??

As I am not so sure this project is free of any bugs or errors so please let me know ofany issues and/or ideas for improvement! The main idea is to get on the air and have fun. Thanks!

<div align="right">

CU on the Bands
73's de Mike,WN2A

</div>

e-mail:

wn2a@qsl.net

P.S. Thanks to my daughter, Jessica for the LABrador icons!

8.0 Disclaimer:

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