User Manual for KD8CEC uBITX firmware rev 1.061

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Introduction

This manual describes features of the KD8CEC firmware (software) revision 1.061 running on a uBITX transceiver.

The KD8CEC firmware ("CECFW" herein) was written by Dr. Ian Lee, KD8CEC. Ian has graciously provided the CECFW to the uBITX community under the GNU public license.

Ian maintains a website http://www.hamskey.com/ which contains up-to-date information on CECFW.

This manual is written for people who have some understanding of the uBITX transceiver hardware as described at http://hfsignals.com/

As shipped, a uBITX has factory firmware ("Factory FW" herein) installed, which was written by Ashar Farhan, designer of the uBITX hardware.

CECFW is an optional alternative to the Factory FW. Many features of CECFW are similar to the Factory FW, both at the operational level, and at the EEPROM byte storage level.

If you install and test CECFW, and then decide to revert to the Factory FW, it is simple to re-install the Factory FW. See
http://ubitx.net/how-to-load-up-a-sketch-on-your-raduino/
for instructions to re-install the Factory FW.

CECFW is open-source, and you can change an modify it to suit your needs, per the GNU public license.

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This manual was written by Rod Davis, KM6SN. Please send any errata or feedback to genuse22@yahoo.com. Please indicate what revision level of this document you are reporting about.

Please note this manual is not an "official" manual, and it is incomplete, and may contain errors.

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Acknowledgments

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Software Installation

CECFW is available in two forms:
    1. a .hex file which can be directly loaded onto the uBITX, or
    2. a collection of software source files with .ino as a file extension, which need to be compiled and uploaded onto the uBITX.

Installing a .hex file

Instructions for installing a .hex file can be found here:

http://www.hamskey.com/2018/01/how-to-upgrade-ubitx-firmware.html

Installing from source files

The CECFW source files are a collection of text files with Arduino programming source code. Each file has a .INO file extension. This collection of files is called an Arduino "sketch". These files must be compiled with the Arduino software development environment, called the Arduino Integrated Development Environment, or Arduino IDE.

The method for CECFW installation is:

A. Use a USB cable and connect your PC to the uBITX.

B. download and install the Arduino IDE. The web page https://www.arduino.cc/en/Main/Software provides a method for downloading and installation. Download the ARDUINO 1.8.5 and install it on your computer.

C. download the CECFW sketch using this link:

https://github.com/phdlee/ubitx

  1. Click on the green field that says "Clone or download"
  2. Click on the blue text "Download ZIP"
  3. Unzip the downloaded file

D. Start the Arduino IDE
  click File
  click Open
  go to the folder …...\ubitx_20\
  click on ubitx_20.ino ; the file will open and you will see text
  click TOOLS
  mouse over the item BOARD
  click on Arduino Nano
  click TOOLS
  mouse over PROCESSOR
  click on ATmega328P
  click TOOLS
  mouse over PORT
  click on the PORT name for the uBITX
  click TOOLS
  mouse over PROGRAMMER
  read this: http://ubitx.net/2018/03/31/1653/
  click on SKETCH
  mouse over UPLOAD and click

The Arduino IDE will prepare the software in a process called compiling, and it will upload the compiled sketch onto the uBITX.

Now you can remove the USB cable and operate the uBITX transceiver on the ham bands.

Initial display

Using the CECFW, when powered-on, the uBITX will initially display something like this:

THE TOP LINE MEANS:

1. CECFW provides two VFOs, VFO A and VFO B. On the top line, 14.072k shows the frequency VFO B is currently tuned to. This is just a reminder. VFO A is the active VFO, shown by the "A:" on the next line.

2. 50Hz - shows the current tune rate; for each click of the encoder the VFO frequency will change by 50 Hz.

3. ST - means the CW mode is currently Straight Key. That means only the key jack tip and sleeve are monitored for key closures.

THE BOTTOM LINE MEANS:

1. LSB – Lower Sideband is the receive and transmit operating mode.

2 A: - VFO A is in use

3. the uBITX is currently tuned to 7.074.000 Hz.

CECFW Menu system

The uBITX has a rotary encoder with a push-switch. In this document, that push-switch is called the "Function SW".

There are four different operational menus that can be selected by pushing the Function SW.

1. Short duration push: invokes the MAIN MENU

2. Medium duration push: invokes the TUNING RATE MENU

3. Long duration push: locks/unlocks the VFO.

4. Push and hold the Function SW during uBITX power-up: this invokes Factory Calibration mode.

MAIN MENU

When you have done a short push on the Function SW, MAIN MENU options appear. You can scroll through the options by turning the encoder knob.
The options, are:

Band Select

Select VFO B? (or, if you are currently using VFO B, this will show VFO A)

Select Mode

RIT: Off, On

IF Shift: Off, On

CW: 20WPM Change

Split On

VFO to Channel

Channel to VFO

CW AutokKey Mode

Setup On   (reveals previously hidden menu items pertaining to setup)

Exit Menu

When you find the menu item you want, push the Function SW. Each menu item will be described in the following section.

Band Select.

This menu displays "Press to confirm". Turn the encoder until the band you want shows up on the bottom line. Then press the Function SW. Note that you can get to a quick exit from this menu by rotating the encoder counter-clockwise (anti-clockwise). When Band Select is displayed, by applying a long-press to the Function SW you can toggle between Ham Band and General Coverage.

Select VFO x.

Selecting this menu option changes which VFO is selected. If VFO A was active, the display will change to VFO B. Conversely, if VFO B was active, the display will change to VFO A.

Select Mode.

Use this menu option to select the transceiver mode of operation. Turn the encoder until the ">" symbol points to the mode you want, then push the Function SW again. The available modes are LSB, USB, CWL, and CWU.

Rit Off On.

Select this menu option to start RIT (Receive Incremental Tuning). Turn the encoder to change the receive frequency. When the frequency is what you want, push the Function SW. **THEN TURN THE ENCODER UNTIL Exit Menu? Is shown,** and push the Function SW again.

In this example:

VFO A is in use, and the uBITX will transmit on 7.274.000, and it will receive on 7.274.850

IF Shift:Off, On

This menu entry adjusts the BFO so that voices sound more natural. Prior to selecting this menu entry tune the uBITX to listen to sideband voice. Then

1. Select the IF Shift:Off,ON

2. Turn the encoder knob until the voice sounds the most natural, then

3 Carefully push the Function SW to save the setting.

Note that when the IF shift value is non-zero, this menu entry will read **IF Shift Change?** A long-press on the Function SW while **IF Shift Change?** is showing will turn IF Shift Off.

Similarly, A long-press on the Function SW while changing the IF Shift value will turn IF Shift Off.

CW 20WPM Change

Turn the encoder until the desired CW speed is displayed, then press the Function SW.

Split On

Press the Function SW to turn Split operation on. To turn Spit operation off, go to the Main Menu, and select menu Split Off? And press the Function SW.

Split operation means using one VFO for receive, and the other VFO for transmit.

VFO to Channel

The CECFW provides the ability to save the current operating environment (VFO selection, mode, etc) in "Channels". You can think of a Channel as a separate and special memory place that persists and endures across power off/on cycles. You can save all of your favorite operating frequencies and modes in these Channels, and recall them later at your convenience.

There are 20 Channels. Turn the encoder to select the Channel you want to use. Channels which have something in them will show the frequency which was saved. Channels which have never been used show as blanks. When you are on the channel you want to use, press the Function SW to store the current environment into the Channel.

Channel to VFO

Use this function to recall the operating environment stored in a Channel. Turn the encoder to show the Channel you want, and then press the Function SW.

Memory Keyer

This section is to be completed.

WSPR Beacon

This section is to be completed.

Setup On

The CECFW has a hidden menu extension to the MAIN MENU functions shown above. Usually they are not accessible. To access these hidden functions, when in the Setup ON menu, press the Function SW.

*Then, the next time you press the Function SW to invoke the Main Menu, turn the encoder past the **Setup Off** function, and continue to turn the encoder past the **Exit Menu** function to reveal additional Setup Menu items.*

TUNING RATE MENU

Note that this is not a part of the Main Menu; to invoke the Tuning Rate Menu hold the Function SW in for a second or so.

This menu entry selects the number of Hz that main tuning will change for each pulse from the encoder.

Turn the encoder until you see the tuning rate you desire, then push the Function Sw.

HARDWARE ARCHITECTURE

A word about uBITX hardware architecture is needed here.

The uBITX is a double-conversion transceiver, with a First IF of 45 MHz, and a Second IF of 12 MHz.

UBITX architecture is shown here:

http://www.hfsignals.com/index.php/ubitx-circuit-description/

The CECFW configures the uBITX as a 12 MHz USB rig, with two front-end mixers to cover the HF ham bands.

For receive operation, starting at the antenna, the **First Mixer** converts the ham band of interest to 45 MHz. The signal is passed through a 45 MHz filter which is about 15 kHz wide, and then on to the **Second Mixer**. The Second Mixer converts the 45 MHz signal to 12 MHz. On transmit, the signal directions are reversed.

The **Third LO** is what is commonly known as the **BFO.** The **Third LO** feeds the **Product Detector**. The **Third LO** frequency is always lower than 12 MHz. ,which is the approximate center frequency of the crystal filter. Therefore, the **Product Detector is always operating in the USB mode**.

In the following examples assume the uBITX is tuned to 7.150 MHz. Frequencies in these examples are approximate.

USB Example

7.150 USB

The First Local Oscillator (**First LO**) feeds the **First Mixer**. The **First LO** always runs at a higher frequency than the ham band being used. In this example the **First LO** runs at approximately 52.140 MHz. Because the First LO is higher than the incoming signal, the First Mixer causes sideband inversion. Therefore, the signal coming out of the First Mixer is now LSB at 45 MHz.

The **Second LO** feeds the **Second Mixer**. Sideband selection is done by a judicious choice of **Second LO** frequencies. In this example, the **Second LO** is runs at 56.990 MHz, which is higher than 45 MHz, and the sidebands are inverted by the **Second Mixer.** Therefore, the output of the **Second Mixer** is USB once again, and at 12 MHz.

LSB Example

The First Local Oscillator (**First LO**) feeds the **First Mixer**. The **First LO** always runs at a higher frequency than the ham band being used. In this example the **First LO** runs at approximately 52.140 MHz. Because the First LO is higher than the incoming signal, the **First Mixer** causes sideband inversion. Therefore, the signal coming out of the **First Mixer** is now USB at 45 MHz.

The **Second LO** feeds the **Second Mixer**. Sideband selection is done by a judicious choice of **Second LO** frequencies. In this example, the **Second LO**

is runs at 32.995 MHz, which is lower than 45 MHz, and the sidebands are NOT inverted by the **Second Mixer.** Therefore, the output of the **Second Mixer** is still USB, but at 12 MHz.

SETUP MENU

The following functions alter uBITX fundamental setups. The reader is strongly encouraged to use the KD8CEC memory manager software on the PC to save the current uBITX settings for a backup prior to modifying any critical items.

Set Calibration

The uBITX uses an SI5351 synthesizer chip to generate 3 frequency sources. The SI5351 has a main reference oscillator on-board that can be accurately calibrated using this menu.

The procedure is:

1. put the ubitx in USB mode

2. connect an antenna to the uBITX to listen WWV; alternatively connect a calibrated signal source at 10 MHz to the antenna input

3. navigate the menus to get to the Set Calibration entry, and press the Function Sw. The uBITX will tune to 10,000,000 Hz, but the display will not show that.

4. rotate the encoder until you hear the zero beat

5. Carefully push the Function SW to save the calibration

As a result of this process, uBITX frequencies will be within a few Hz of the dial setting.

For those who have access to a high resolution frequency counter, as an alternative to the above, you can:

connect the uBITX to the counter via a pad of at least 20 db, and hold the CW key down while adjusting the uBITX encoder until you see on the frequency is exact. Then carefully push the Function SW to save the calibration.

Set the BFO

Set the BFO frequency used in USB and LSB. Rotate the encoder to vary the BFO frequency, then press the mic PTT switch to confirm. If you do not want to change the BFO frequency, press the function switch to abort.

Set CW RX BFO

Set the BFO frequency used in USB and LSB. Rotate the encoder to vary the BFO frequency, then press the mic PTT switch to confirm. If you do not want to change the BFO frequency, press the function switch to abort.

Change CW Tone

Set the CW sidetone frequency. Rotate the encoder to vary the CW sidetone frequency, then press the mic PTT switch to confirm. If you do not want to change the BFO frequency, press the function switch to abort.

CW TX-RX Delay

CW Start Delay

Change Key Type

This menu entry controls how the key contact closures are handeled.

Rotate the encoder to chose one of Straight key, or keyer IambicA mode, or keyar IambicB mode, then push the Function Sw.

ADC Line Monitor

TX OFF

Exit Menu?

FACTORY CALIBRATION MODE

To be written. Volunteers can contribute suggestions for this section.

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UBITX CAT control The CECFW emulates a subset of the Yaesu FT-817 CAT protocol.

To use PC software with uBITX CAT:

1. use a USB cable to connect the PC to the uBITX

2. in PC software, select Yaesu FT-817

3. select 38400 baud, 8 bits, no parity, 2 stop bits.

uBITX Memory Manger

The uBITX Memory Manger software ("MMSW" herein) runs on a PC that is connected to a uBITX.

There is a group of data on the uBITX that is stored in a re-writeable memory called EEPROM. The MMSW provides the functions to

1. Connect to the uBitx

2. read the uBITX EEPROM data from the uBITX, and

3. decode the EEPROM data into human-recognizable entries, and

4. change the EEPROM data, and

5. encode the human-reconizable entries into hexadecimal, and

6. write the EEPROM data to the uBITX, and

7. write the EEPROM data to a file on the PC (with a .btx file extension), thereby providing a backup system for the uBITX settings, and

8. load a .btx file into the MMSW, allowing one to encode the data and then write it to the uBITX to restore uBITX settings

A separate manual will explain the features of the Memory Manager in more detail.

Installing Memory Manager

on Microsoft® Windows®

https://github.com/phdlee/ubitx/releases/download/v1.06/ubitx_Manager1.01.zip

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on Linux®

http://www.hamskey.com/2018/02/running-ubitx-manager-on-linux.html

On Linux systems, you must install Mono, an the open-source software that provides a .NET framework.

Then, invoke the Memory Manager using the command-line like this;
mono uBITX_Manager.exe

Linux users- note that you must check the Linux Compatibility Mode box in the upper left corner. Also be aware in the serial port selection window you may have to use the down-arrow to scroll far enough down to find /dev/ttyUSB0