

W0EB/W2CTX Software Operating Manual for the MicroBITX Transceiver Using The BITEensio Micro-Controller with an I2C LCD display Manual Version 1.25

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One of the MicroBITX transceivers constructed by Jim, W0EB

INTRO:

This software operating documentation will be somewhat different than our other offerings. Since changing to the Teensy 3.6 MPU from the Arduino Nano, we will assume the user has the ability to download the files and program the MPU using the Arduino IDE with the “TeensyDuino” add-ons installed. We will no longer include those instructions in these documents and the published manual’s version# will not necessarily reflect the version # of the software it refers to.

New revisions of this document will be issued only when sufficient changes to the normal operation of the software defined herein have been made to warrant such changes. Minor revisions to the software will be documented in a “change log” README file that will be included in the ZIP archive for a particular version and will be available as soon as practical in the Documentation download directory of the files link at www.w0eb.com.

Every effort will be made to ensure that website has the latest versions of our software available for download within a reasonable time after release.

Hardware considerations and items necessary for operation:

There is a power jumper on the backside of the Teensy 3.6 as shown on the card that came with your Teensy. It says this should be cut to separate VIN (Teensy power) from VUSB (power supplied through the USB port) if you are using external power. You MUST cut this jumper before first powering up your BITensio card!!!! This will keep BITensio power to the Teensy from conflicting with power from the USB port and possibly destroying your Teensy!

W0EB/W2CTX/N5IB “BITensio” Controller board with a Teensy 3.6 MPU containing at least a 1 gigabyte microSD card (16 gig max) formatted FAT32.

The original encoder and function switch (may be on the encoder or installed as a separate pushbutton) are still connected to the card via the uBITX’s 8 pin “Digital” connector. They will be used mainly for tuning the frequency of the uBITX (encoder) and selecting the tuning rate cursor (function button). They also may

be used for tuning and selection during the Alignment phase of the Configuration menu (covered later in this document).

One additional encoder and five additional pushbutton switches (minimum) will be required for operation of the BITeansio software and more may be added in future releases. You will also need a 1 gigabyte to 16 gigabyte micro SD card (formatted as FAT32), inserted in the Teensy's micro SD slot prior to continuing at least for the first time you run any of the Teensy software. If not, SD DISK FAIL -> EEPROM will appear briefly and you may have trouble running the configuration menu (explained later). We originally thought SD cards up to 32 gigabytes could be used but recently found out the max size is 16 gigs which should be more than adequate.

A second, encoder connected to Teensy digital I/O pins D26 (Enc-A), D27 (Enc-B) and the encoder common to ground is used for paging through the menu selections which are called up by a medium press on the menu's "Enter/Exit button (connected to input D29 and ground). The menu's "Choose" button (connected to input D30 and ground) is used to select the desired menu item.

In addition to the normal menu system explained in the following paragraphs, see Appendix A

Using the buttons and Menu System:

Buttons:

1. `FREQ_INCR/RIT` button: (original encoder's function button)

This button controls frequency increment, RIT on/off and frequency LOCK.

A short press will decrease the frequency increment value used by the Tuning encoder. When the frequency increment reaches the lowest increment available then it will move to the highest increment.

A long press will control RIT operation. If RIT is currently OFF then "RIT ON" will be displayed and upon release RIT will be turned ON. However, if SPLIT is currently activated, this action will be ignored and SPLIT will remain active. If RIT is currently ON then "RIT OFF" will be displayed and upon release of the button RIT will be turned off.

An even longer press of the main function key will LOCK the frequency encoder so an accidental bump of the encoder knob will not cause the frequency to jump or move. Pressing it again for the same long time will turn the LOCK back off.

Menu System operation:

The menu system is controlled by two buttons and an encoder. There is a "Menu Enter/Exit" button and a "Menu Choose" button. To move between menu items use the "Menu Select" encoder.

1.0 The menu system has two major menu items: MENU and CONFIGURATION. There is a last option which is "EXIT" to allow getting out of the menu without changing anything. Pressing and holding the "Menu Enter/Exit" button will cycle through the three options and will stop at "Exit". Releasing the button will select the option currently being displayed. Having selected "MENU" or "CONFIGURATION" you can still exit the menu by depressing of the "Menu Enter/Exit" button.

2.0 Having selected "Menu", two lines are displayed representing your choices. The cursor will be placed on the last selected choice allowing faster access to that item. For example if the last item selected was MEM(LMC) then the next time you get into the menu the cursor will still be there so you can repeat changing the memory channel. Using the Menu Select encoder move the cursor to the item you want to change. To select the item the cursor is under, press "Menu Choose" until "change" is displayed. Then release the button.

You will notice that as you use the "Menu Select" encoder some of the menu items might be skipped based on the current "mode".

2.1 Menu item Mode:

Having selected this menu item you can move thru the modes available with the use of the “Menu Select” encoder. After selecting the mode you want depress the “Menu Enter/Exit” button until “change is displayed then release the button. The selected mode will be entered. Modes are CW, CWr (reverse sideband) CWP (CW Code Practice) USB, LSB, SWU (Short Wave Listen USB) SWL (Short Wave Listen LSB). TX is inhibited in CWP, SWU and SWL modes to prevent accidental transmission.

2.2 Menu item Paddle State:

This menu item is a “toggle” menu item. Press the “Menu Choose” button until “change” is displayed then release the button. The paddle state will toggle between normal(N) and reverse(R).

2.3 Menu item Iambic Mode:

This menu item is a “toggle” menu item. Press the “Menu Choose” button until “change” is displayed then release the button. The iambic mode will toggle between iambic A and iambic B.

2.4 Menu item CW Sidetone:

This menu item sets the CW sidetone frequency. Press the “Menu Choose” button until “change” is displayed then release the button. Now using the “Menu Select” encoder change to the desired frequency. Then depress the “Menu Enter/Exit” button. (Sidetone volume level can now be controlled by a trimmer resistor, VR1 on the back side of the BITeensio board.)

2.5 Menu item CW Keyer Speed:

This menu item sets the CW keyer speed. Pressing the “Menu Choose” button until “change” is displayed then release the button. Now using the “Menu Select” encoder change to the desired speed. Then depress the “Menu Enter/Exit” button.

2.6 Memory Channels:

The use of memory channels requires the addition of 2 push button switches

connected to the BITeensio P5 Header.

The Memory Channel and Bank switches take up pins D24 and D25 on P5. Memory Bank select is on D24 and Channel Select is on D25 (commons are grounded as usual).

Memory frequencies have been configured into 4 banks of 10 channels (0-9) each. These banks are called CW SSB DIG and USR. CW, SSB and DIG are pre-configured to the QRP operating frequencies for that mode, per band, in software and cannot be changed by the user. USR mode is user configurable (frequency AND mode) by tuning the uBITX to the desired frequency and mode, selecting the USR memory bank and performing the "Store" function.

The CW, SSB and DIG banks are fixed with the QRP frequencies for those modes on the various bands. You use the bank select button to toggle through the 3 banks. When you find the one you want, hold the button in until "Load" appears. Release and that bank will be available. The other button selects the channel (0-9) in that bank and as you toggle through the channels, the actual frequency will display below the channel#. Hold the button in until "Load" appears, release it and that frequency will be loaded into the A vfo. The USR bank can be loaded with custom frequencies and to do that you first select USR, and "Load" it with the bank selector button.

Next, toggle to the memory channel (0-9) you want to store a frequency in. Tune the uBITX to the desired mode and frequency. Hold the memory channel button past "Load" until "Store" appears, release the button and your frequency will be stored in that USR channel until you change it to something else. This info is kept on the SD card so it won't work if you don't have at least some size (up to 16 gig formatted FAT32) SD card inserted.

3.0 CONFIGURATION. Having selected the CONFIGURATION menu there are currently 9 available configuration items.

CONFIGURATION allows the user to tailor his uBITX based on hardware he has added to the base system.

To enter the CONFIGURATION menu depress the “Menu Enter/Exit” button until “CONFIGURATION” is displayed. Then release the button. Once in the configuration menus you can exit anytime by depressing the “Menu Enter/Exit” button. Use the “Menu Select” encoder to select the option you want to change. Then use the “Menu Choose” button to enter the selection.

3.1 OSC LOAD XTAL allows the user to select the load capacitance of the crystal. Press “Menu Choose” to enter this item. Use the “Menu Select” encoder to select the value proper for your radio. On the BITeansio card, the crystal has a load capacitance of 10pF but others may have different values. If your oscillator crystal has a load capacitance value other than the 3 (6, 8 or 10pF) provided values, use the one closest to an available selection. To save your selection depress “Menu Choose” button.

3.2 CALIBRATE allows the user to calibrate the accuracy of the radio. Each item in the “Calibrate” selection will prompt you with the correct action needed for that step.

3.3 VOLTS DISPLAY allows the user to turn the voltage monitor display on or off. The proper hardware must be installed for this to work on the RadI2Cino card but is built in on the newer BITeansio. To save your selection press the “Menu Choose” button.

3.4 CALIBRATE VOLTMETER allows the user to change a constant that is used to calculate the displayed voltage. Use the “Menu Select” encoder to adjust the bottom displayed voltage to match the supply voltage that you are using to power the radio. Then press the “Menu Choose” button to save this value. The voltage displayed should now reflect the voltage applied to the radio.

3.5 CW Filter IN/OUT reserved for a hardware CW filter that may be added to Version 4.0 uBITX boards.

3.6 S-METER DISPLAY allows the user to turn on or off the S-meter display. The appropriate hardware must be installed. Use the “Menu Select” encoder to select the value proper for your radio. To save your selection press the “Menu Choose” button.

3.7 CAT BAUD RATE allows user to select baud rate for serial connection to external control software. The radio must be power cycled to have new baud rate take effect. Use the “Menu select” encoder to pick the baud rate you want. Depress the “Menu Choose” button to save the selection and turn the radio off then back on to complete the save. The serial port defaults to 8 bits, no parity, and one stop bit.

3.8 BACKUP EEPROM DATA allows the user to save current values in EEPROM into microSD. This allows the user to initialize a new microSD. Once selected the data will be automatically move to microSD. Success or failure is presented to the user. To exit press “Menu Choose” button.

3.9 SET TIME allows the user to set the real-time clock in the Teensy 3.6 MPU. (The CR2032 coin cell “Backup” battery needs to be installed to keep the clock running when power is removed from the radio, otherwise you will have to set the time every time you use it.) When selected, this item uses the “Menu Select” encoder to step through the available choices. The first is “Select Month”. Use the encoder to select the current month and press the “Menu Choose” button to save it and move to “Select Day”. Use the encoder to set and the “Menu Chose” button to save it. The same procedure is used to step through and select the year, hour, and minute. Once you have all the selections properly selected, press the “Menu Chose” button again to set the clock and exit the CONFIGURATION menu. If you accidentally enter the Set Time menu and don’t need to set the time, simply press the “Menu Select” button again and you will return to the radio’s operational mode with the date and time unchanged.

There will be one additional push button switch assigned to the P5 Header’s D31 pin, labeled “DISPLAY” which will be used to step through display items on the screen such as Input Voltage (the only item we currently display) or future items that may utilize this display area. Right now, this switch does nothing as only the input Voltage display is currently used. This switch may be installed now if desired but will be inactive until other display items are added.

Appendix A: Keyboard.

The Teensy (3.6 only) MPU has the capability of implementing a USB “Host” mode and if you look at your Teensy 3.6 from the top side, just to the right of the USB “Micro B” input jack, there are a series of white outlined 5 holes. Carefully solder a 5 pin header into these holes with the long side of the pins sticking out the top side of the Teensy. You will have to order the 5 pin USB Host cable from PJRC.com (very inexpensive) and connect it to this header to be able to use the KB function we’ve added to this firmware.

The red wire (power to the KB) MUST be connected to the pin that has the white square around it on the Teensy.

The USB connector on the end not connected to the Teensy should be mounted to the uBITX front or side panel to allow a Keyboard to be plugged in.

Do NOT use a lighted keyboard as it will draw too much current from the BITeansio card and could cause damage to the Teensy AND the BITeansio card

The keyboard may be used without the uBITX being plugged into a computer and so far we have tested several 2.4GHz (not Bluetooth) wireless keyboards and they work well. The choice of wired or wireless is strictly up to the user and you may or may not get the same results we did so experiment to make sure your keyboard will work.

We have implemented a fairly comprehensive command list which covers most if not all of the available menu functions used in normal operation.

A fully functional Keyboard CW keyer for transmit is also included. We are not implementing a CW decoder and the reason we are not including a

decoder is to encourage CW operators to learn to copy in their heads or at least on paper and to NOT send faster than they are capable of copying. CW decoders are extremely unreliable under noisy/QRM conditions and the possibility for decode errors causing errors in decoding call signs or other critical QSO data is too great. The best Morse Code decoder is still the human brain.

COMMAND LIST:

Currently there are two types of commands:

The following take effect immediately with NO Parameter entry –
(Command immediately toggles the item)

- <CTRL>c Puts the system into Keyboard CW keyer mode - <ESC> exits.
There is a 64 character type-ahead buffer and the input is displayed on the top line of the display. When the end of the 20 character line is reached, the characters will continue to scroll to the left and exit the screen to the left. During the time the KB CW Keyer is active, once you start typing, the uBITX goes into CW Transmit mode and stays in TX until 4 seconds after you stop typing or <ESC> is entered. If you don't exit KB CW mode with either the <ENTER> or the <ESC> key, typing another character puts it right back into TX again and will stay there for 4 seconds after the last character is typed or <ENTER> is used to exit the KB Keyer mode. If you need to stop the keyer in the middle of a transmission, the <ESC> key will terminate sending and keyer mode immediately. To exit the keyer when you are done using it the normal exit mode is the press the "Carriage Return" (<ENTER>) key.

- <CTRL>m change mode (toggles through CW CWr, USB, LSB, SWU, SWL and back to CW) Mode change takes place immediately.
- <CTRL>i toggle iambic (mode A or B)
- <CTRL>l toggle frequency encoder LOCK
- <CTRL>p toggle paddle (N or R)
- <CTRL>v toggle VFO (rotates through A-B)

<CTRL>r toggle RIT (RIT-ON or RIT-OFF)
<CTRL>s toggle SPLIT (SPLIT-ON or SPLIT-OFF)
(When SPLIT is ON, then <CTRL>v selects T or R VFO for frequency entry)

The following commands require the <CTRL> command and then a parameter entry followed by <enter> to change value or <esc> to cancel the command.

<CTRL>fxxxxxxx - set active vfo frequency

No leading zeros are needed but the trailing ones are. For example, to set the active VFO to 7.040.000 MHz would take: <CTRL>f (brings up blank 3rd line on display), type 7040000 and then press <enter>.

<CTRL>wxx set CW speed 5 =< xx <= 50

(Examples - <CTRL>w, blanks the line, type 05 <enter> sets 5 WPM, <CTRL>w then 25 <enter>, sets 25 WPM)

<CTRL>txxx set CW tone 100=< xxx <= 990

(<CTRL>t blanks the line, type 3 digits from 100 to 990 and then <enter> sets the entered value)

With Parameter entry an "Enter" completes the input.

With Parameter entry an "Esc" terminates command with no change.

With Parameter entry the value is tested against a range and a display tells user if outside range.

The error message will be something like "Bad Input" and the bad command is cleared so you can start over.

Keyboard CW Keyer (Additional):

The KB can be used as a CW keyer (see info above) and as of this document, only the normal letters, numbers and punctuation keys have been mapped. There are no "Pro Signs" (BT, SK, AR, etc) mapped in the system yet but they are coming and will be as close to those used in the K1EL commercial keyboard keyers as possible.

Besides the normal letters and numbers , the full character map including punctuation has been implemented is as follows:

(There are several other key assignments that are treated just like letters and are buffered. These transmitted characters are sent as the two letters run together.)

= is mapped to BT
< is mapped to AR
> is mapped to SK
/ is mapped to DN
; is mapped to KR
@ is mapped to AC
! is mapped to CM
(is mapped to KN
\$ is mapped to VU
) is mapped to KK
“ is mapped to AF
- is mapped to DU
' is mapped to WG
_ is mapped to UK
: is mapped to OS
+ is mapped to AR

This document will be revised and re-published as other commands are created.

Credits:

This document and subsequent versions will be available in the W0EB/W2CTX uBITX Files section of the <http://www.w0eb.com> website.

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